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Railway Mechanical Engineer

FOUNDED IN 1832

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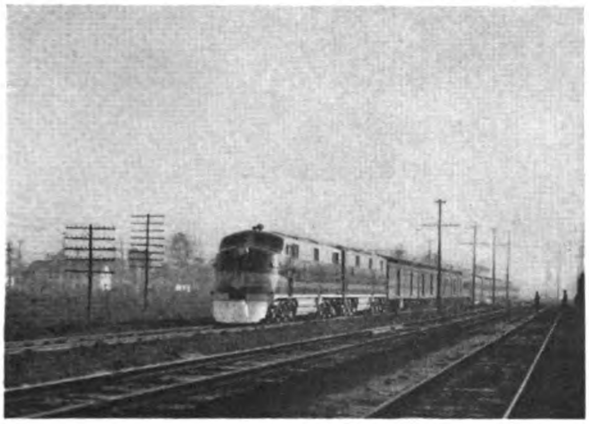

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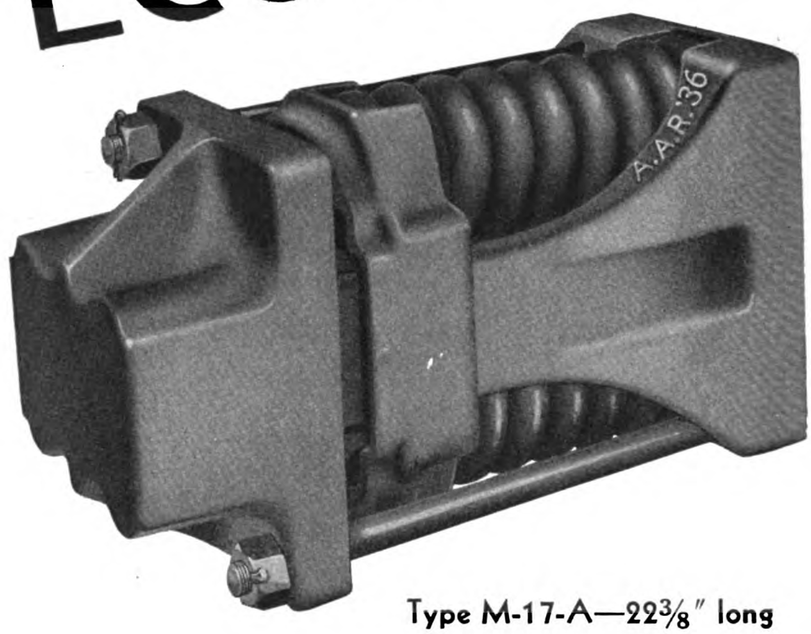

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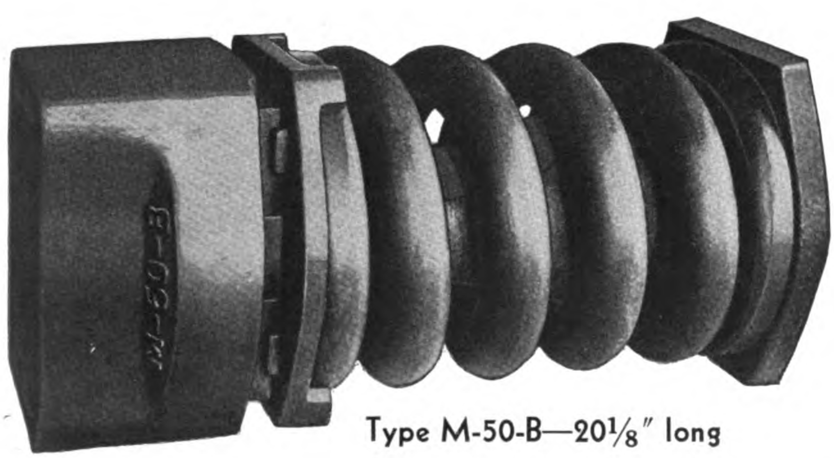

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RAILWAY MECHANICAL ENGINEER

The Evolution of

The Locomotive in France*

By Lawford H. Fry †

In the December issue of the *Railway Mechanical Engineer,* a review of Mr. Chapelon's book was begun, but the important section on Thermal and Thermodynamic Studies of the Steam Locomotive was reserved for more detailed consideration. The study covered by this section is not purely academic theory. Much of it originated in a desire to increase the power of existing locomotives; and as a result of this study and of the experiments made for its support, definite and important improvements were made.

Work began some fifteen years ago when many novel types of turbine and high-pressure locomotives were being built and discussed. The French railways required an increase in locomotive power, but felt that before starting out along these new paths the possibilities of the more conventional designs should be thoroughly explored.

As a result of extensive study, the Paris-Orleans Railway decided in 1924 to rebuild along improved lines one of their Pacific type locomotives. The engine chosen was a four-cylinder compound superheated Pacific type locomotive of the class built from 1910 to 1914. On the basis of theoretical study and experimental work it was believed that increased power could be obtained in three ways:

1—Improvement in the exhaust and front end so as to obtain greater boiler power while reducing the amount of back pressure required to produce draft. This reduction of back pressure would increase the engine power available.

2—Increase in the cross-sectional area of the steam passages between boiler and exhaust. This would reduce wire drawing and its attendant losses and by reducing back pressure would increase efficiency and facilitate high-speed running.

3—Increase in the steam temperature to reduce cylinder condensation with its attendant losses.

Practical Application to P.-O. Locomotives

The preliminary studies and experiments gave grounds for believing that by taking advantage of all possibilities in these three directions, the locomotives then developing about 2,000 hp. could be rebuilt to deliver approximately 3,000 i.hp. Mr. Chapelon shows that the results met all predictions. Before considering the theoretical studies a brief account of the practical developments is given.

Exhaust and Front End

The system used is the "Kylchap," developed by Mr. Chapelon on the basis of the distributor introduced by the Finnish engineer, Mr. Kylala. Two stacks are used, each having an independent draft rigging and nozzle. The blast nozzle is circular with Goodfellow bars. The nozzle discharges the steam into the wide circular bell-mouth of the distributor. This distributor at a short distance above the nozzle splits into four passages which taper so as to reduce the area slightly. The steam and gases are discharged from the distributor in four jets directly into the wide circular mouth of a petticoat pipe which ends a few inches below the lower rim of the wide bell-mouth of the stack extension.

The test results quoted for this draft arrangement show it to be highly efficient. Whether the Kylchap arrangement is compared with the earlier French drafting or with modern American practice, great improvement is shown. With 8 lb. per sq. in. of back pressure the Kylchap draft in the remodeled Orleans locomotive produces a smokebox draft about 18 in. of water. In the older Orleans locomotives and in American practice this same back pressure, 8 lb. per sq. in., would give a draft of only about 8.5 in. of water. To produce the draft necessary to give full boiler power without the Kylchap exhaust, it would be necessary to carry the back pressure 8 or 10 lb. per sq. in. higher. With a 22-in. by 28-in. cylinder locomotive at diameter speed, a reduction of 10 lb. per sq. in. in back pressure means an increase of 360 hp. in the indicated cylinder horsepower.

Steam Passages

Mr. Chapelon points out that in earlier studies of locomotive thermodynamics insufficient attention had been given to providing sufficient cross-sectional area for the steam passages in the cylinders. Tradition prevailed and the ratio of port area to piston area remained for many years about 1 to 10. Similar proportions are not uncommon in American practice. Definite improvement was made by the Northern Railway of France in 1907 when steam passages were increased 25 per cent to permit high speeds with low driving-wheel diameters. With this precedent the Paris-Orleans decided to go still further, practically doubling the steam passages and thus dividing by four the loss of pressure due to wire drawing. At the same time the volume of the steam chests was increased. This helped to equalize the pressure in the steam chest throughout the stroke.

Superheat

The steam temperature was increased to 750 deg. F. and by increasing the steam passages through the superheater, the pressure drop between throttle and high-pressure cylinders was greatly reduced.

With the changes indicated, the Paris-Orleans in 1934 rebuilt a 4-6-2 Pacific type, replacing the trailer with an additional pair of drivers, thus producing a 4-8-0 engine which, as has been indicated, with an increase of only 11 tons in weight enabled the indicated horsepower to be increased from 2,200 to 3,700.

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* Part II of a review of La Locomotive a Vapeur by André Chapelon, assistant chief engineer of design of equipment, Paris-Orleans-Midi Railway, published by J. B. Bailliere et Fils, 19, Rue Hautefeuille, Paris, 6e, France. Price, 125 francs.

† Railway engineer, Edgewater Steel Co., Pittsburgh, Pa.

With these figures to show the theoretical studies have been used to definite practical purpose, the Section on Thermal and Thermodynamic Studies of the Steam Locomotive is reviewed.

Corelation of Two Streams of Fluid Flow

The first chapter deals with Fluids in Movement and examines the fundamental relationships connecting boiler, engine and exhaust with the tractive force, speed and horsepower developed.

The operation of the steam locomotive depends on two streams of fluid flow which originate separately and join at the exit of the exhaust nozzle. In one channel the fuel and atmospheric air combine in the firebox to form gases of combustion which flow through the tubes to the smokebox and stack. In this channel heat is developed and transferred as far as possible to the steam in the other channel, in which the water is evaporated, the steam superheated, and then part of the transferred heat is transformed into mechanical work in the cylinders. Finally part of the heat energy remaining in the steam is utilized in the exhaust to maintain the flow of gases. The expansion of the steam in the exhaust induces the flow of gases on which combustion and hence the production of the steam depends. This linked flow beginning and ending in the exhaust nozzle is, as Mr. Chapelon points out, self-supporting. The steam exhausted produces sufficient draft to maintain the combustion required to evaporate the steam required to produce the draft. The cycle involves the complicated interplay of a number of actions and reactions, physical, chemical, and mechanical. The chapter under consideration attempts an analysis of the details of the cycle.

The Flow of Gas and Air

Eight so-called Laws are set up, but these are better described as approximations and not as laws. As, however, the approximate relations are compared with those derived experimentally, the method is instructive. Starting with the exhaust nozzle, the back pressure is shown to be very nearly proportional to the square of the rate of flow of steam; the smokebox draft is nearly proportional to the back pressure, but does not increase quite so rapidly as the latter when the rate of evaporation is increased; the loss of pressure in the steam between boiler and steam chests is approximately proportional to the square of the rate of flow of steam and inversely to the square of the cross-sectional area of the passages.

These three relations are dealt with satisfactorily, but in the next, Law IV, more difficulty is encountered. The relation involved is that which leads to balance between the steam exhausted and the steam produced. The links in this relationship are: the amount of steam exhausted determines the smokebox draft; the draft and the resistance of the boiler determine the rate at which air is taken in; and the rate of air supply determines the rate of combustion and steam production. The relationship is correctly stated, and Mr. Chapelon concludes that as boiler output increases, there is a decrease in the amount of air taken in per pound of coal burned, and at the same time a slight decrease in the resistance of the boiler to the flow of gas.

This last conclusion is arrived at from theoretical considerations with very little experimental data in support. Direct information could have been obtained by plotting weight of gases moved against smokebox draft. By doing this the reviewer has found that the resistance offered by the boiler to the flow of air and smokebox gases remains constant until, at very high rates of firing, the fire begins to lift on the grate. In the Pennsylvania Mla locomotive the boiler resistance is constant up to a boiler output of about 50,000 lb. of steam per hour. Until that rate of evaporation is reached, the weight of gases moved is directly proportional to the square root of the smokebox draft, and it is found that very nearly one-half of the draft is required to move the gases through the tube bundle, the remaining half overcoming the resistance in the smokebox and through the grate.

Mr. Chapelon's analysis of these phases of boiler operation lacks completeness because he is not able to offer any definite information as to the weight of gas moved in relation to the weight of steam exhausted. This ratio of weight of gas to weight of steam is the only proper criterion of the effectiveness of the exhaust. In this country methods have been developed for using locomotive smokebox gas analysis to compute the weight of coal actually burned and the weight of gas moved. Mr. Chapelon notices this method, but expresses doubt as to its reliability. It is unfortunate that he did not explore its possibilities when making the elaborate tests of the Orleans engines on the road and on the test plant. He would then be in a better position to decide as to the merits of the method. As it is, while rejecting the method in principle, he quotes on several occasions Altoona test plant results which were computed by it.

After this digression, we note that the analysis of the flow of gas and air is closed by plotting boiler efficiency and evaporation with rate of coal fired as abscissa. Mr. Chapelon credits this form of plot to the present reviewer. This method of plotting has the advantages that it leads to a straight line relation between efficiency and rate of firing and that from this it follows that the evaporation tends to a maximum value at an efficiency just half that indicated by the straight line if extended back to zero rate of firing.

The Steam Flow

This concludes the examination of the combustion side of the flow and attention is turned to the travel of the steam from boiler through the cylinders to exhaust. The interrelations of steam pressures and steam temperatures, pressure drop to cylinders, cut-off, and back pressure are studied by an algebraic analysis which cannot be summarized here. It deserves careful study, as it emphasizes the individual importance of the various factors which control the development of power in the cylinders.

Mr. Chapelon calls particular attention to the advantage of providing steam passages of ample cross section so as to reduce pressure drop and back pressure to a minimum. Figures are given to show how piston leakage and cylinder-wall effect reduce the amount of power that can be developed. The loss from this source decreases as cut-off is shortened and speed is increased, while steam-pressure losses ahead of and back of the pistons increase with speed and rate of steam flow. The net result is that as the speed is increased, with cut-off constant, the cylinder tractive force drops, but not so rapidly as would be the case if the cylinder losses were not reduced by the increase in speed.

Plots of experimental results from the Paris-Orleans locomotives show that for each cut-off the cylinder effort drops with increasing speed following a straight-line relationship. The slope of the lines for the short cut-offs is much less than the slope for the longer cut-offs. Also for the same cut-off the modern locomotives with ample steam passages show a much less rapid drop in cylinder effort as speed increases; in fact with the shorter cut-offs the line is very nearly horizontal, indicating that until the limit of the boiler capacity is reached, cylinder tractive force does not drop as speed increases. This is shown to be most important in its influence on the amount of steam required per indicated horsepower-hour. In the locomotives with steam passages of conventional cross-section the curve for steam per indicated

horsepower-hour plotted on indicated horsepower as abscissa drops at first, showing an increase in efficiency, but as the horsepower increases the greater flow of steam builds up back pressure in the restricted passages and the curve turns up, showing a rapid drop in efficiency. This means a rapid increase in steam consumption and consequently a comparatively low ceiling for the horsepower that can be developed. With enlarged steam passages the curve for steam per horsepower-hour is flattened out at the higher horsepowers, and a greater horsepower output is possible.

The Boiler and Fuels

The boiler comes next for study. After some notes on types of fuel including tabulation of the petrographic constituents of coal a glance is thrown in the direction of the firing shovel, the firebox door, as well as the Hulson grate and the Standard stoker. The pulverized coal burners experimented with on the German State Railways are pictured, together with two oil burners. Then, coming to the practical use of coal fuel, Mr. Chapelon contributes a valuable and interesting chapter. He points out that the value of a coal as a locomotive fuel is closely connected with its coking power. The coking power of the coal is of importance not only in keeping the fine coal from being carried off the grate, but in insuring that the fire forms a porous permeable bed. This is essential if the boiler is to be driven to high capacity. To determine the value of a coal as locomotive fuel, it is not sufficient to determine its heating value, the melting point of the ash, and to make proximate and ultimate analyses. It is of the highest importance to know how the coal will behave in the firebox.

To emphasize this point, figures are given for locomotive tests with two apparently similar coals. The proximate analyses were:

	A	B
Coal:		
Upper heating value, B.t.u. per lb.	15,480	15,120
Ash, per cent	4.1	4.8
Volatile matter, per cent	21 to 22	17 to 19
Moisture, per cent	2.1	2.0
Boiler efficiency at		
80 lb. per sq. ft. grate per hr., per cent	67	75
165 lb. per sq. ft. grate per hr., per cent	49	57
Smokebox draft at		
80 lb. per sq. ft. grate per hr., in. of water	3.5	5.0
165 lb. per sq. ft. grate per hr., in. of water	12.2	14.7

These figures are taken from an elaborate series of tests with four Pacific type locomotives run by the same fireman. In all cases 60 per cent of coal and 40 per cent of briquettes were fired, the briquettes being the same for both series of tests. The only difference between the two coals was that *A* had been in stock for a longer time and the consequent oxidization had reduced its coking power. In the firebox the fresh freely coking coal *B* formed a permeable fire-bed through which the air flowed uniformly giving efficient combustion. This accounts for the higher draft with coal *B*. Although the higher draft produced a slightly higher spark loss, the better combustion in the fire-bed gave a higher net boiler efficiency with coal *B*. Mr. Chapelon concludes that for locomotive use the coking power of a coal is at least as important as, if not more important than, its heating value. Methods of studying the coking power of coals are noted.

Combustion

In closing the chapter on combustion, Mr. Chapelon gives figures for the air required and the heating value of a wide variety of fuels solid, liquid, and gaseous. From these it appears that whatever fuel is used, the heat released per pound of air required will be very nearly constant. Translated into American units, Mr. Chapelon's figures show that for each pound of air burned, 1,270 B.t.u. will be produced. The reviewer's notebook carries an entry several years old giving 1,360 B.t.u. per pound of air. For mnemonic convenience a figure of 1,300 B.t.u. per pound of air can be taken. The constancy of this figure explains why the boiler barrel and front end are only slightly affected by the kind of fuel to be burned.

A short chapter deals with the theory of the exhaust. Plotting with smokebox drafts as abscissae it is shown that the curve representing the amount of steam produced by the draft is concave downwards, while the curve representing the amount of steam required to produce the draft is concave upwards. Evidently the draft value at which the two curves cross is that corresponding to the maximum capacity of the boiler. Mr. Chapelon points out that an inefficient front end can be forced to high draft and high boiler capacity, but at the expense of building up a high back pressure, which reduces the power of the engine. Comparison of various locomotives shows that for an equivalent evaporation of 60,000 lb. per hour, the smokebox draft required is 12.6 in. for locomotive No. 4700 and 13.0 in. for locomotive No. 4500. To produce these practically identical drafts No. 4700 with Kylchap exhaust operated with a back pressure of 5.5 lb. per sq. in., while No. 4500 with the old trefoil nozzle required 15.0 lb. per sq. in. At a speed of 68 miles an hour this represents a net difference of 365 hp. That is to say, if locomotive No. 4700 developing 2,000 hp. at the drawbar had its Kylchap exhaust replaced by the old trefoil, the drawbar horsepower would be reduced to 1,635, a reduction of 18 per cent. Put the other way round, drawbar horsepower can be increased 22.5 per cent by changing from the old to an improved type of front end. The figures deserve serious consideration on this side of the Atlantic.

The chapter on the Production of Heat then presents a sketchy account of the mechanics of combustion in the firebox, a theoretical discussion of the heat which can be produced per unit of firebox volume, and winds up with a series of curves for French and German locomotives burning respectively hand- and stoker-fired coal, pulverized coal and oil. The curves plot boiler efficiency and evaporation against rate of firing and show that the differences between one style of firing and the other are hardly greater than the variations between locomotives of different types using the same style of firing.

Heat Transmission and Absorption

The chapter following discusses Heat Transmission in firebox, flues, and superheater. Transmission by radiation in the firebox is handled mathematically and the usual Stephan-Boltzmann law is obtained showing that the rate of transmission is proportional to the difference between the fourth powers of the absolute temperatures of the radiating and receiving surfaces. The value given by Mr. Chapelon for the coefficient by which the fourth power difference is multiplied to give B.t.u. radiated per square foot of surface is about 35 per cent lower than the value which the reviewer has used. It is, therefore, a matter for regret that Mr. Chapelon offers this value without quoting any source and without comparing computed results with test data.

In dealing with transmission by convection in the flues, the drop of gas temperature along the flue is assumed to follow an exponential law, and the constants required are derived from a curve of temperature drop attributed to the Pennsylvania Railroad. The formula obtained is used to study the effect of variations in boiler proportions. It is pointed out that a change in flue dimensions which increases efficiency of heat transfer increases at the same time the resistance to the flow of the gases. A general equation for drop of pressure because of flue resistance is given, but no numerical values are given.

A general study of superheater proportions is made and eight different designs are compared.

To provide information as to the relative heat absorption in firebox and flues, Mr. Chapelon uses H. S. Vincent's work at some length, but decides that in view of the difficulty of measuring firebox temperatures and in determining the weight of gases of combustion, the results quoted must be considered as provisional only. It is perfectly true that values reported for firebox temperatures must be used with reasonable care, but Mr. Chapelon's position regarding the determination of the weights of the gases of combustion does not seem to be so well founded and is not entirely consistent. In discussing the efficiency of absorption of the boiler heating surfaces, the statement is made that this efficiency varies little from one locomotive to another and is only slightly affected by the rate at which the boiler works. This statement is supported by curves derived from a number of tests made on American locomotive plants. Now this efficiency of absorption can be found only when the weight of gases of combustion is known, so that the accuracy of the values of absorption efficiency given by Mr. Chapelon is entirely dependent on the accuracy with which the weight of the gases of combustion has been determined.

The same holds for Mr. Chapelon's figure showing for the Pennsylvania Mla locomotive the over-all boiler efficiency, as well as the efficiencies of heat production and heat absorption. The over-all efficiency is measured directly and is split into the efficiencies of heat production and absorption, the computation requiring a knowledge of the weight of the products of combustion. The smooth curves in both of the figures referred to indicate that there is no undue inaccuracy in the determination of the weight of the gases of combustion. It seems a pity that Mr. Chapelon did not give greater attention to the problem of measuring the weight of the gases of production. If an effective analysis of boiler operation is to be made, knowledge of the weight of air supplied is as fundamentally essential as knowledge of the weight of coal fired. In many of his discussions of the action of the boiler, Mr. Chapelon can give definite information only because methods for determination of the air supply have been developed in this country. The extensive tests made with the Orleans locomotives on the road and on the Vitry test plant offered excellent opportunities for confirming or correcting these methods. It is to be regretted that this was not done.

The effect of feedwater heating is analyzed, leading to the following conclusions: feedwater heating is more effective with high steam pressures than with low; feedwater heating leads to a slight decrease in the amount of superheat; the saving in heat is greater than the saving in water, and the saving in coal is greater than the saving in heat. A brief survey of exhaust injectors and feedwater heater closes the section devoted to the boiler.

Action of Steam in the Cylinders

The Section devoted to the Action of Steam in the Cylinders is the most important part of the book. It starts with first principles, introducing the general study of thermo-dynamics by a quotation of some length from Sadi Carnot's "Reflections on the Motive Power of Fire," 1824, and following this by Clausius, 1888. The thermodynamic theory of the steam engine is developed and is then used to show the possible advantages of high boiler pressures and more particularly of low exhaust pressures. Theory is not divorced from practical considerations, as Mr. Chapelon emphasizes the fact that real improvement is not necessarily obtained by improving the Rankine cycle. It is important to see that the improvements are effective in the locomotive as built. This is kept well in mind in discussing the effect of high pressures and of superheat.

Theoretical diagrams are shown for the Rankine cycle for pressures of 64, 240, and 850 lb. per sq. in. absolute with saturated steam and with steam at 750 deg. F., respectively. Expansion is supposed to extend down to 15 lb. per sq. in. absolute. The thermal efficiencies are:

Steam pressure lb. per sq. in.	Thermal efficiency		Gain by superheat per cent	Humidity of steam after expansion	
	Saturated	750° F.		Saturated	Superheated
64	9.4	12.0	27.7	8.5	0.0
240	17.3	19.5	12.7	16.0	2.5
850	23.6	25.6	8.5	24.6	13.4

At first sight it appears that the gain by superheating decreases as the pressure increases. Actually, however, this is not the case. The increasing ratio of expansion required for the high pressures brings with it a considerable amount of condensation in the cylinder. The action of the cylinder walls, which makes the efficiency of the real cycle lower than that of the Rankine, increases with the humidity of the steam. Therefore, with the higher pressures, high superheat is essential to prevent condensation during expansion. This whole section of the book is valuable in establishing basic theoretical relations which must be recognized in any intelligent attempt to improve the steam locomotive. It is by following the principles thus established that the very highly efficient Orleans locomotives have been developed. In view of the fact that these locomotives are four-cylinder compounds, Mr. Chapelon's discussion of compounding is of considerable interest. The present reviewer made the acquaintance of the compound locomotive more than a third of a century ago and still thinks that it is worthy of careful consideration in American practice. Students of Mr. Chapelon will probably agree.

Mr. Chapelon's use of the entropy diagrams in analyzing the action of the steam in locomotive cylinders shows clearly the very large losses produced by wiredrawing of the steam in entering and leaving the cylinders. It was a study of this kind which led to the decision of the Paris-Orleans Railway to rebuild their Pacific type locomotives with greatly enlarged steam passages. Mr. Chapelon points out that in the early days of the steam engine the ratio of 5 to 1 for area of piston to area of steam passages was recommended and used by successful builders of stationary engines, but with the development of the locomotive steam passage areas were reduced, either with the idea of reducing external heat losses, or to save weight; the ratio of 10 to 1 for piston area to steam passage area was adopted. This ratio was followed with almost religious exactitude until the Paris-Orleans broke with tradition and opened the way to greater efficiency and greater power. Incidentally, it is noted that if full advantage is to be taken of passages of large area, steam chests of ample volume must be provided. A volume at least equal to that of one cylinder is recommended for the steam chest. The object of this volume is to equalize during each stroke the flow of steam through the passages. With too small a steam-chest volume, the pressure in the chest will show violent fluctuations.

The opening up of the steam passages played a considerable part in the improvement made by the Paris-Orleans in their Pacific type locomotives. As already pointed out, these locomotives were rebuilt with a view to obtaining greater power. The front end was modified to use a double Kylchap exhaust with two stacks, the superheater was modified to give greater superheat with less loss of pressure, and the area of the steam pipes was increased from one-tenth to one-fifth of the area of the piston. As a result the indicated horsepower was increased from a value of 2,200 to about 3,700 hp. Of this increase about one-half is attributed to the increase in the size of the steam passages, while a large part of the remainder was due to the greater efficiency of the

front end which enabled a lower back pressure to be used. In this connection Mr. Chapelon points out that improvement in the front end permitting the use of a larger blast nozzle cannot be effective unless the exhaust steam passages are of ample cross section. To produce an effective blast the nozzle must be the most constricted area of the exhaust passages. Therefore, the area of blast nozzle required for the required steam production must be determined and the steam passages then proportioned to have an area larger than that of the nozzle.

At this point Mr. Chapelon gives no theoretical guidance for the design of the blast nozzle. He says that the blast has two functions. In the first place, the nozzle and distributors must mix the steam with the gases of combustion in effective fashion so that the latter are drawn through the flues and front end. No equations are available; experience must govern. In the second place, after gathering the gases, the steam expands with them through the stack, driving against atmospheric pressure to maintain the draft in the smokebox. This expansion and the relation of stack to nozzle diameter are more amenable to theory and computation.

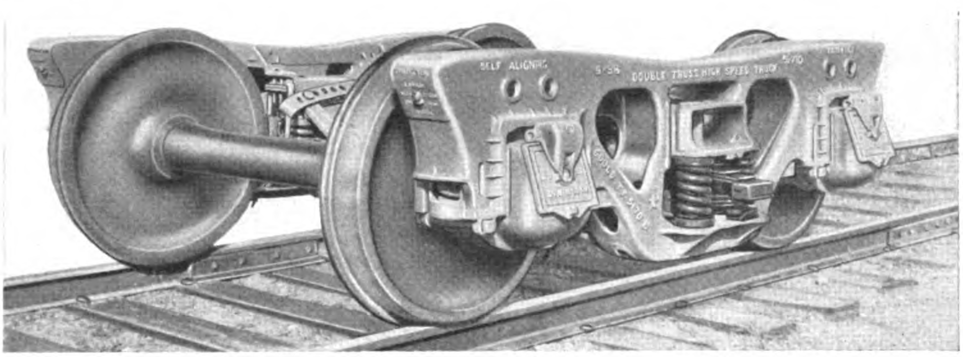
In dealing with the effect of exhaust, back pressure, steam temperature, single expansion vs. compounding, etc. Mr. Chapelon presents a considerable number of comparative diagrams of novel pattern which are very effective for the purpose. As abscissae, are plotted values of coal, water or calories used per hour, while, as ordinates, are plotted values of horsepower-hours per pound of coal, per pound of water, or per calorie, according to the comparison that is to be made. The scale used is logarithmic so that curves of equal horsepower are parallel sloping straight lines. If curves are plotted for the data to be compared, direct visual comparison is easy either at equal rates of consumption or at equal rates of power output. As a result of the logarithmic plotting the distance between any two points on the same vertical is directly proportional to the percentage difference in efficiency.

Mr. Chapelon's analysis of the action of the engine in transforming heat into work is extensive and covers many phases which cannot be dealt with here. The original is warmly recommended to those who read French. Various types of poppet valve mechanisms are glanced at, but to this reviewer the thermodynamic studies of steam action and the comparisons with experimental data constitute the most interesting and important part. Something of the same sort is wanted in English, but it is certain that a comparable amount of acceptable test data could not be assembled. Even without this a statement of the basic thermodynamic facts would be valuable. It might serve as a reminder that a mere increase in dimensions is not always the best way to obtain more power. This is emphasized by the rebuilt Paris-Orleans Pacific type locomotive, round which so much of Mr. Chapelon's book is built. These engines originally gave an indicated horsepower of 2,200. By intelligent redesign they were able to deliver 3,700 i. hp., with an increase in weight of only 11 tons.

Modified Freight Truck For High-Speed Service

For more than three years the Symington-Gould Corporation has been studying the design of a truck for intermediate freight service which would approximate the riding performance of passenger type trucks but with a relatively slight increase in weight and cost over that of the present integral box freight truck. This study has involved a long series of road tests under the company's instrumented test cars, which were used some years ago by a sub-committee of the A. A. R. Car Construction Committee in its study of the comparative riding qualities of various types of non-harmonic bolster spring groups.

The company is now offering a high-speed truck capable of safe operation at speeds up to at least 90 m.p.h. and basically a development from and a refinement of the double-truss spring-plankless self-aligning integral-box truck now in service under or on order for about 50,000 cars. The column and bolster end construction is of the characteristic self-aligning design which permits the temporary lead of one side frame over the other on entering curves and a prompt restoration to normal on leaving, without loss of bearing area, and therefore with a reduced rate of wear of column faces and bolsters. The bolster used is identical with that for the spring-plankless self-aligning integral-box truck. The bolster spring group may be of the preferred "coil-elliptic" type or any combination of coils with an efficient snubber.



Symington-Gould double-truss high-speed truck

To obtain the necessary further improvement in riding quality and safety, through prompter equalization of wheel loads at speeds in excess of 60 m.p.h., and to protect the side frames against direct rail shocks, separate boxes are used, each supporting one end of the side frame on a parallel spring group consisting of one semi-elliptic spring mounted on the box roof and two helical coil springs mounted on journal-box side brackets. This group has a total travel of 1-5/8 in., thereby doubling the total spring travel between rail and center plate with a sevenfold improvement in riding quality over that of the integral-box truck with non-harmonic spring groups, as determined by the A. A. R. method of test. The semi-elliptic springs are completely enclosed within the side-frame ends except for inspection holes and the normal

(*Continued on page 15*)

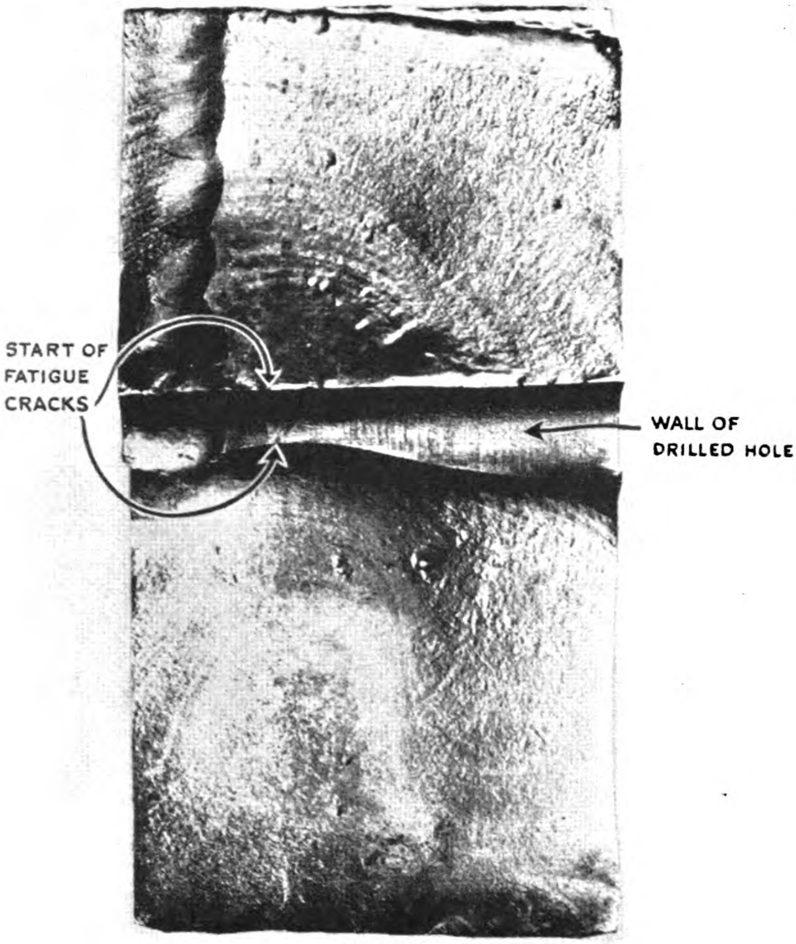


FIG. 1

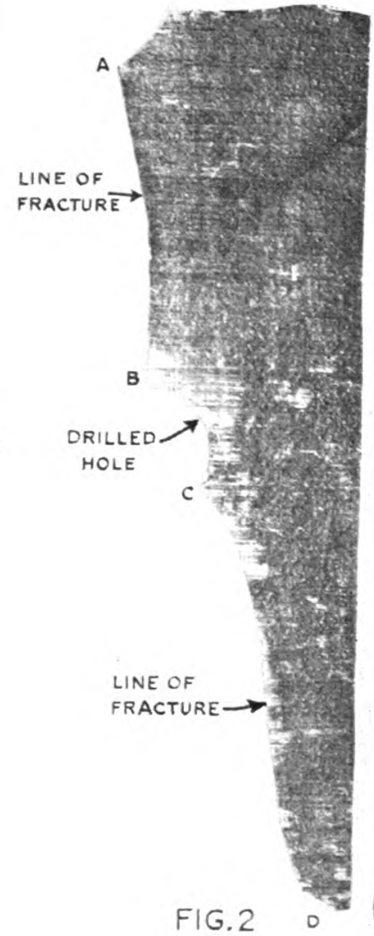


FIG. 2

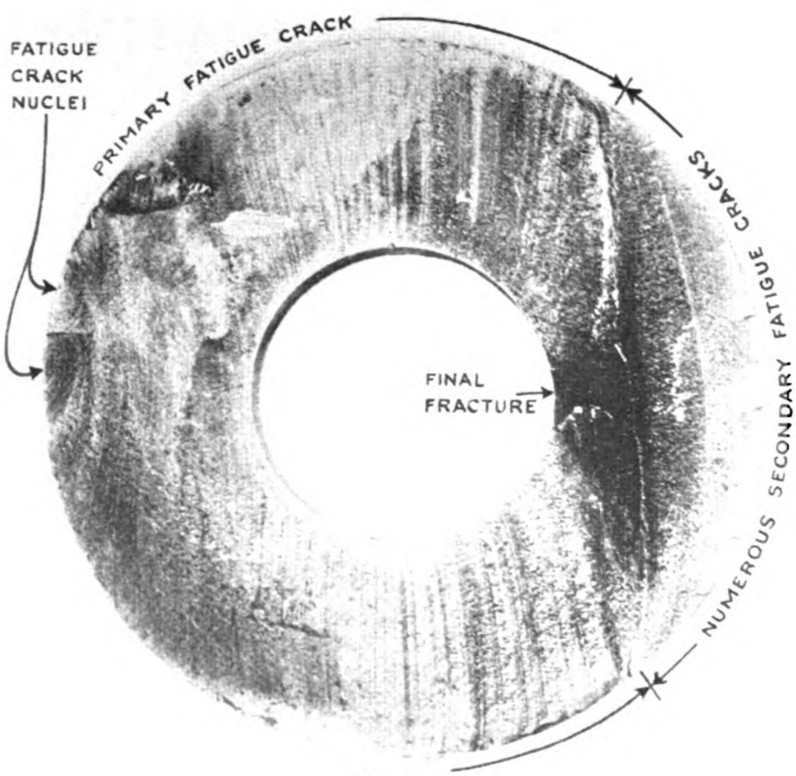


FIG. 3

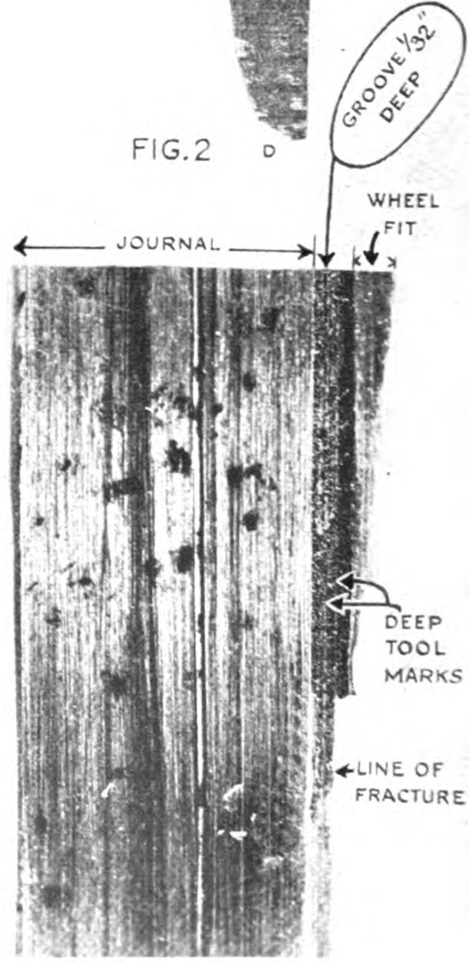


FIG. 4

Failures of

Locomotive and Car Parts

By
Frederick H. Williams, M. Sc., F.R.S.A.

THIS article considers several special types of failures of locomotive and car parts, rounding out and supplementing material presented in previous articles of the series.

Drilling Steel Parts

In considering the failure of locomotive parts because of poor machining, special attention may well be directed to the importance of the proper drilling of steel parts. An instance in which an engine frame failed because a drill was not cutting clean and tore the surface of the walls of the drilled hole, is illustrated in Figs. 1 and 2. The rough and badly torn surface from which the fatigue cracks started is clearly evident in Fig. 1. The surface of the fracture indicates that there were two fatigue cracks, both of which started from the drilled surface. It is hard to imagine that there could be much flexing of the steel in such a large cross section. The frame at the break was five inches wide and much deeper, and yet there was sufficient flexure in the mid-section, through which the bolt hole passed, to start the fatigue cracks. It at least indicates how little flexing is required to start a crack where conditions are such that the stresses can be concentrated on rough and torn surfaces.

A side view of part of the broken frame, Fig. 2, shows the course of the break—almost straight upward from the top of the hole in one instance, and diagonally downward from the side of the hole in the other. A study of these two photographs, and particularly of the surface of the break in Fig. 1, would seem to indicate that the fatigue crack at the top started first and was well advanced or completed before the one at the bottom started. This insance of the failure of a large part, taken in conqunction with previous articles in this series, when similar breaks were illustrated on much smaller sections, indicates that no part of a locomotive, subject to reverse stresses, is free from possibilities of failure if the machined surfaces are rough or scored.

Fig. 1—Surface of fracture of broken engine frame; fatigue cracks developed from the torn surface of the drilled hole. Fig. 2—Side view of broken engine frame shown in Fig. 1. Fig. 3—Fractured surface of locomotive axle which failed in service; the cracks started in a rough undercutting adjacent to the wheel fit. Fig. 4—Side view of part of the broken locomotive axle shown in Fig. 3; note the deep tool marks in the section between the journal and the wheel fit.

The economical operation of a locomotive depends upon its utilization in service, and unnecessary days spent in the roundhouse or shops for repairs detract just so much from its value to the company. It is, of course, true that one may make a fetish of smooth and polished surfaces, and yet such failures as have been described in this series of articles indicates conclusively that smooth finishes, with proper fillets and rounded corners, are an important factor in insuring long and useful life, particularly of parts subject to reverse stresses.

Locomotive Axles

Failures of locomotive axles were considered in a previous article*, but a recent failure is a bit unusual and worthy of consideration. The fractured end of the axle in question is shown in Fig. 3. It is quite apparent that several fatigue cracks around a considerable part of the circumference, finally joined together and caused the failure. Apparently, however, the quality of the steel was so excellent that the cracks extended over practically 90 per cent of the section before the break occurred. A certain amount of satisfaction can be derived from the fact that the material so stubbornly resisted the stresses and finally gave way only when a very small portion remained intact.

A side view of a section of the broken axle is shown in Fig. 4. The part at the left is the journal, and the darker part at the right and joining the journal to the wheel fit, is a groove or gutter about $\frac{1}{32}$ in. deep. Such a gutter $\frac{1}{64}$ in. deep would have caused a failure. This one, at least twice as deep, was rather rough cut with two rather deep tool marks in it. The fatigue crack at the lower part of the fractured edge followed one of the tool marks for about 12 in., most of the nuclei of the fatigue cracks occurring within this section. Since the undercutting was done deliberately, there must have been some reason or objective for so doing, but certainly it should have been smooth finished, without score marks or tool marks. Most of us have seen piston rods, undercut in this way adjacent to the taper fit, which have lasted the entire lifetime of the rod, because of being properly finished. Indeed, sometimes such an undercutting is so deep that subsequent turnings of the shank of the rod do not call for a new fillet, and yet they have proved satisfactory.

Manufacturers of parts which fail sometimes insist that the failures were caused by too much flexure. You can flex a steel part indefinitely, however, just as long as you do not allow the stresses to concentrate and exceed a predetermined load. If we make the parts so strong that there will be little if any flexure, they will be too heavy to be of any use. Reduction in weight of the locomotive and its parts to a minimum is extremely important from the standpoint of operating efficiency. It is advisable, therefore, that the finishing of such parts be given unusual consideration, in order to insure the very best possible use from the materials and designs of which they are built.

Improperly Cut Equalizer Bar

Acetylene cutting has marked advantages. Care must be taken, however, to use it only under favorable conditions. Carelessness on the part of the operator should not be tolerated and unusual care should be exercised in hurried or rush operations. An instance in which poor work was done, which resulted in the fracture of an equalizer bar of a baggage car, is illustrated in Figs. 5, 6 and 7. The bar did not fit properly in place and a portion of it (*a-b*, Fig. 5) was cut away with an acetylene torch. Fatigue cracks started in the burned and rough surface at *b*; these cracks extended from *b* to *c* before the rest of the section from *c* to *d* finally gave way. The

* *Railway Mechanical Engineer*, January, 1938, page 15.

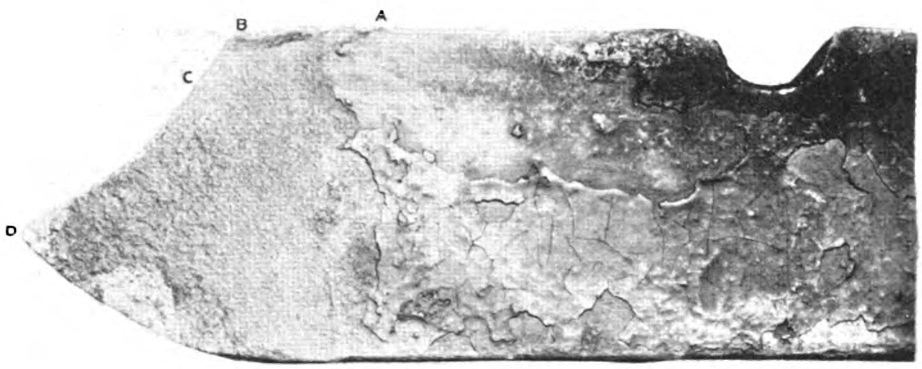


FIG. 5

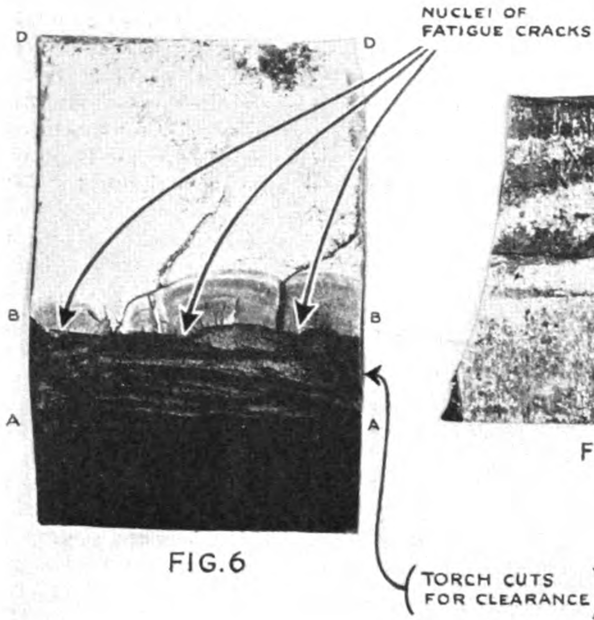


FIG. 6

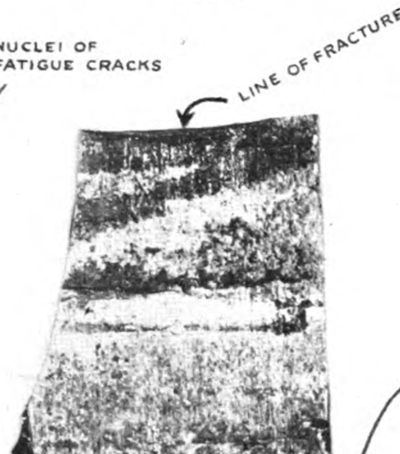


FIG. 8

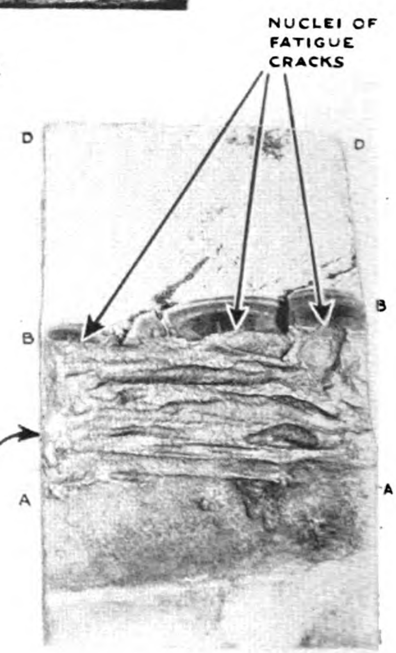


FIG. 7

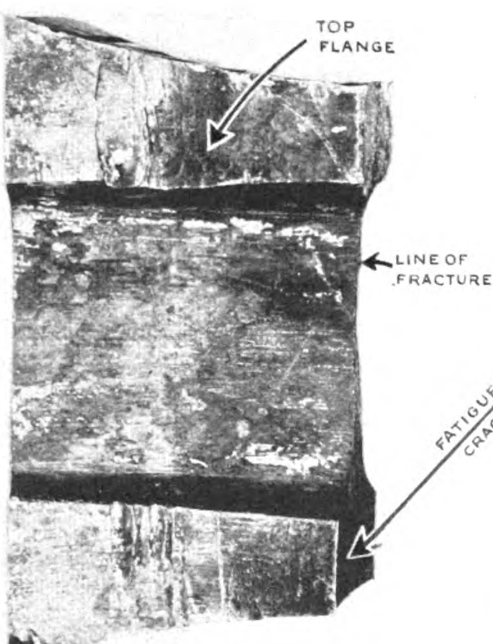


FIG. 9

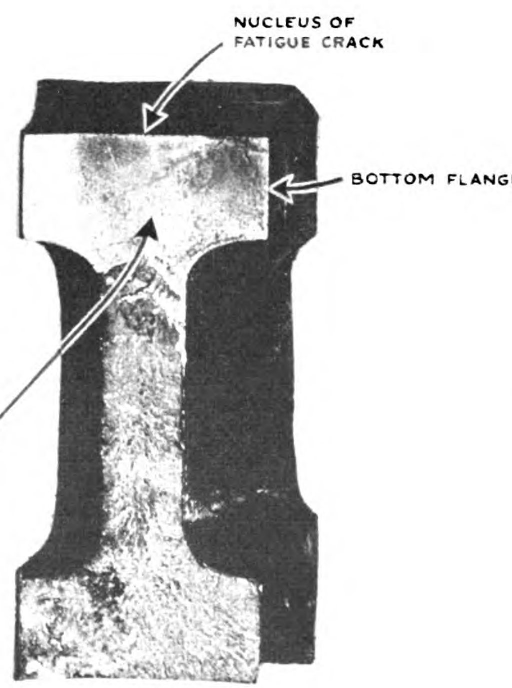


FIG. 10

bar was made of steel and the molten metal cooled in such a way as to leave a hard brittle surface, readily susceptible to the starting and developing of fatigue cracks. Figs. 6 and 7 show the fractured surfaces, as well as the rough surface from which the fatigue cracks started.

The cutting of carbon steel, when the carbon content is over 15 per cent, is attended with danger and the higher the carbon content, the greater the danger. The cutting of steel changes the structure of the material and sets up strains, making heat treatment necessary. Plain annealing is ordinarily used in treating side rods which have been cut to shape; but to insure good results, the steel is generally preheated to about 1,200 deg. F. before the cutting, and the cutting is done while the steel is hot.

Fig. 5—Side view of part of a broken baggage car equalizer bar; material was cut off between A and B by an acetylene torch, apparently to provide proper clearance. Figs. 6 and 7—Fractured surfaces of broken equalizer bar, showing the development of the fatigue cracks; also the rough surface left by the cutting torch. Fig. 8—Partial view of top of fractured side rod, showing rough surface caused by gripping jaws used in lengthening the rod. Figs. 9 and 10—Views of fractured side rod, part of which is shown in Fig. 8.

Side Rod Failure

A form of failure of a side rod which is quite common, is illustrated in Figs. 8, 9 and 10. Side rods are sometimes elongated by heating and stretching them in a machine which grips the rod near the ends. The gripping jaws are likely to make dents in the rod, from which fatigue cracks may start. Such a deformation is illustrated in the partial view of a side rod shown in Fig. 8. Side and end views of the fracture are shown in Figs. 9 and 10. Incidentally, if the fracture had not started where it did, other bad deformations which are quite apparent in Fig. 9 would surely have caused trouble. Obviously the surface of the rod should have been refinished after the length was adjusted, and the scars and dents removed.

The rather miscellaneous series of failures which are pictured in this article illustrate clearly the necessity of greater care in performing the ordinary operations of repair work in railroad shops; not only this, but they emphasize the necessity for careful and critical inspection of all repair work, and particularly of those parts which are subjected to alternate stresses.

Anderson Spark Eliminator

After several years of experimenting on the Chicago, Milwaukee, St. Paul & Pacific with various styles of Anderson spark eliminators, also known as arresters, the open-type, shown in one of the illustrations, has been adopted and about 150 of these are now in service in both freight and passenger locomotives on the Milwaukee.

The thirty 4-8-4 heavy combination freight and passenger locomotives, recently delivered by the Baldwin Locomotive Works, also have these spark eliminators and the six 4-6-4 streamlined passenger locomotives, delivered to the Milwaukee this fall by the American Locomotive Company, are equipped with the same device.

Many difficulties were encountered and eventually overcome during the process of development, the main problem being to obtain free-steaming locomotives and yet not throw sparks from the stacks. With ordinary bituminous coal this would be a relatively easy matter, but in the territories where semi-lignite is burned the elimination of sparks is a serious problem. However, the Anderson open-type spark eliminator which was finally developed and adopted is said to be giving highly satisfactory results as evidenced by extensive service tests on the Milwaukee and by a joint report of the state forestry inspectors of Wisconsin and Minnesota after they had made several observation trips in the cupola of a caboose immediately behind a locomotive equipped with this style of arrester. During these tests, wooden planks and chips were thrown into the firebox,

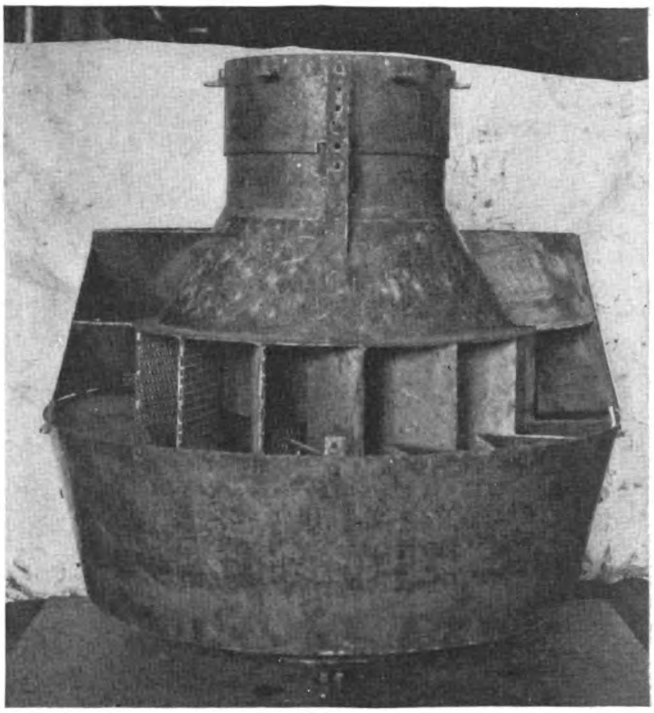


Fig. 1—One of the earlier styles of Anderson spark eliminator with a portion of the front section removed

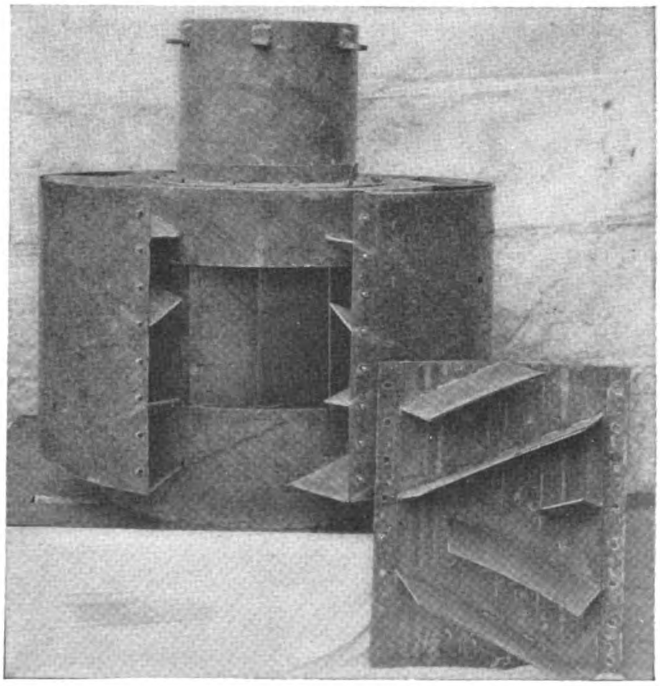


Fig. 2—Anderson closed-type spark eliminator with front section removed

but it is reported that even with such a severe test no sparks came out of the stack.

Other arresters were developed on the Milwaukee besides those illustrated, all of which are fully covered by patents, but those immediately preceding the present open-type arrester are shown in Figs. 1 and 2. That shown in Fig. 1 had both an inner and outer arrester, with numerous vanes for eliminating the sparks. This style was abandoned after the type shown in Fig. 2 was developed due to the expense of manufacture and maintenance, and having to remove it from the front end whenever work was required on the units and flues. As can be seen in Fig. 2, this type of spark eliminator had a door to facilitate work on the nozzle and arrester. This also had to be removed when it became necessary to do any work on units and flues. This style was discontinued after the open-type eliminator with a tapered inside stack, as shown in Fig. 3, was developed.

Referring to Fig. 3, the essential part of the open-type eliminator is the vertical vanes that are set at a specified angle between the top and bottom plates. The surfaces of these vanes break up and eliminate the sparks. The rear portion of the table plate has apertures cut in it by making U-cuts with a torch and by bending downward and forward the metal inside these cuts. The rear edges of these apertures form lips which extend below the table plate and act as scoops to admit a considerable amount of the smokebox gases to the rear half of the arrester. This smokebox gas and that portion which passes forward under the table plate causes the entire circumference of the spark eliminator to be used and due to this condition the sparks are mostly extinguished by a straight impact due to their momentum rather than by a continuous circular motion around the inside of the eliminator.

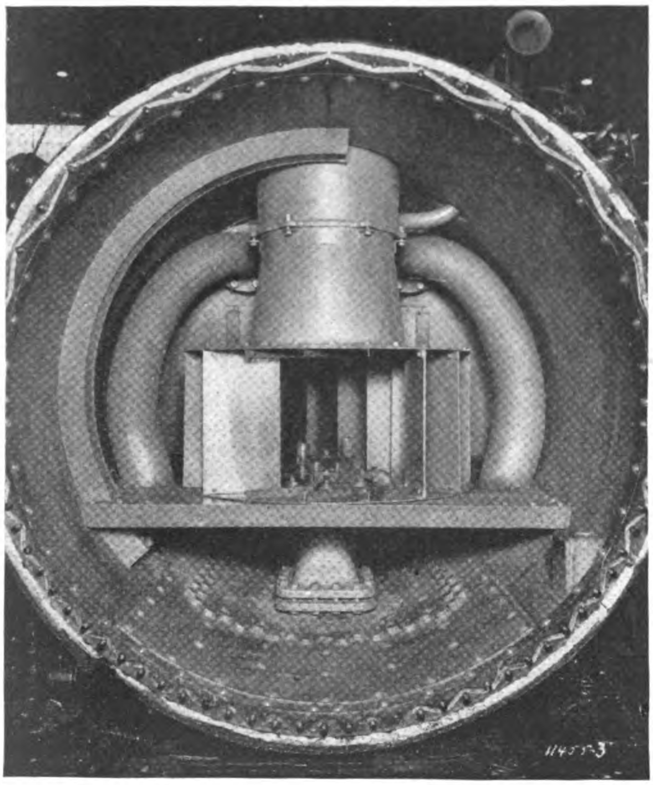


Fig. 3—The Anderson open-type spark eliminator with three of the vanes removed to show the exhaust nozzle

Since the outlet to the stack is at the vertical center line and the flow from all directions is towards this section, there is but little whirling action in the eliminator itself. This fact is borne out by the service secured from the vanes which would tend to be quite limited if they were set at such an angle as to give a pronounced circular motion to the incoming gases and sparks. In the course of time these vanes wear at the inner edges due to the gas passage area being considerably less here than at the outer circumference, but since all the vanes are made reversible this wear is not an objectionable feature.

The angle of the vanes and their width determine the efficiency of the eliminator. These two items of the design were determined by experiment, but are also controlled to some extent by the size of the smokebox. However, the gas area through the vanes should be more than 100 per cent of the flue area through the front tube sheet. That shown in Fig. 3 is maintained at 128 per cent of the flue area for this particular class of engine and no sparks are being thrown from the stack when bituminous coal is burned. If there were, the only change that would be necessary would be to change the width of the vanes from 14 in. to some greater distance. If the change happened to be from 14 in. to 16 in. the area through the eliminator would be reduced from 128 per cent to 108 per cent of the flue area.

In territories where a semi-lignite coal is being burned the eliminator shown in Fig. 3 is operated with vanes 18 in. wide, thereby reducing the gas area to 78 per cent. This is apparently considerably more than that obtained with netting-type front ends. Although they may be designed to give 200 per cent of the flue area, the frictional resistance that the gases have to overcome to get through the netting is high and due to their construction, large sections of the netting are not used. Moreover, the sections through which the gases pass are often half plugged with cinders that have wedged themselves into the open spaces. There also have been many instances when foaming or priming has made the exhaust steam wet and heavy enough to cause the front end netting to become plastered over sufficiently to cause steam failures. An arrester without netting or perforated sheets eliminates this potential source of trouble.

The top plate of the Anderson open-type spark eliminator shown in Fig. 3 is divided at the center line so that one-half at a time can be taken out through the smokebox door or set to one side in the smokebox when necessary to work on the units or flues. This work can also be done by unbolting and removing a few of the vanes when not necessary to remove the top plate to allow a free passage to these parts.

Although a tapered inside stack extension is shown in Fig. 3, a straight cast iron inside stack is also used and is quite satisfactory when round nozzles are employed. This style extends into the eliminator a few inches and is supported by an integral collar on its upper end which fits into a suitable recess in the stack base. It can be easily taken out by removing the main stack and pulling the extension up through the stack base. The tapered inside stack is bolted in place. A metal spacer ring rests between the top of the eliminator and the extension flange on the bottom of this style inside stack and since this ring is about ⅛ in. thicker than the telescopic joint at the top, the stack extension drops down sufficiently to clear the main stack when the ring is removed. In this way, this style of inside stack extension can be removed and passed through the smokebox door without removing any part of the eliminator.

This spark eliminator is being used successfully with prong, choke-bore, plain-bore and annular-ported nozzles. It has also brought about the general use of increased

(*Continued on page 15*)

Production Methods Used in Construction of

Milwaukee Welded Flat Cars

New 50-ton cars embody unit principle of construction and are designed to accommodate loads which are both heavy and bulky

In the construction of 500 all-welded flat cars now in progress at the Milwaukee shops of the Chicago, Milwaukee, St. Paul & Pacific, the principle of unit construction is utilized to fabricate the various parts of the cars before the assembly operations are carried out. This principle has been utilized in previous car construction programs on the Milwaukee. In accordance with the practice of that road in building new cars, separate jigs are used for the fabrication of such individual parts as bolsters, cross-bearers, center-sill sections and end sills. After the fabrication of these individual units, they move to an assembly line where the various units are welded together to make up the final steel assembly. In subsequent positions, couplers, draft gears and air-brake equipment are applied. The trucks are assembled separately.

The present series of cars, the construction of which is described in the article, are 52 ft. 6 in. long over the end sills, 53 ft. 3 in. over the striking castings; have a capacity of 50 tons; and weight approximately 45,600 lb.

In the development of this flat car, the principal objectives have been to adhere to Association of American Railroad standards; conform to loading requirements; provide minimum initial and operating costs; and meet, as nearly as possible, shippers' requirements for this class of equipment. The unusually large deck, 52 ft. 6 in. long by 10 ft. 6 in. wide, is especially advantageous to manufacturers who desire to ship tractors, threshers and similar equipment requiring maximum-width cars.

The car has been designed from a welding standpoint throughout, using ordinary low-carbon steel, and stresses have been computed with a relatively high factor of safety. Standard mill sections, plates and bars with standard mill tolerances are employed and these have a definite bearing on cost reduction.

Owing to the substantial thickness of the plates used in the car, it has been necessary to use $\frac{1}{4}$-in. and $\frac{5}{16}$-in. welding rods except in isolated parts where $\frac{3}{16}$-in. is used. The majority of the welding is intermittent with a ratio of 1:1 except in the region of the bolsters. Here, continuous welding is carried out using fillets of $\frac{1}{4}$ in. Both transformer-type and motor-generator-type welding machines are being used.

Fabrication of the Principal Structural Units

The center sills consist of two built-up sections, each comprising a web plate (cut to fish-belly shape), one upper chord angle and two lower chord angles. Each section is built up on a jig accommodating two, one of which is being set up while the other is being welded. This gives a high operating factor; i.e., per cent of time the arc is in operation; and since the majority of the welding is in a downhand position, maximum efficiency results. The completed sections are delivered by an overhead crane direct to the center-sill assembly jig. Here they are welded to a top cover plate while center-sill spreaders are welded on, center-filler and striking castings riveted in place and couplers and draft gears applied. This jig accommodates two such set-ups to cut idle time to a minimum.

Each side sill consists of a web plate (cut to fish-belly shape), one lower chord angle and a top cover plate. These are welded together on a jig built to take two such assemblies, and the 15 stake pockets are then welded to each sill.

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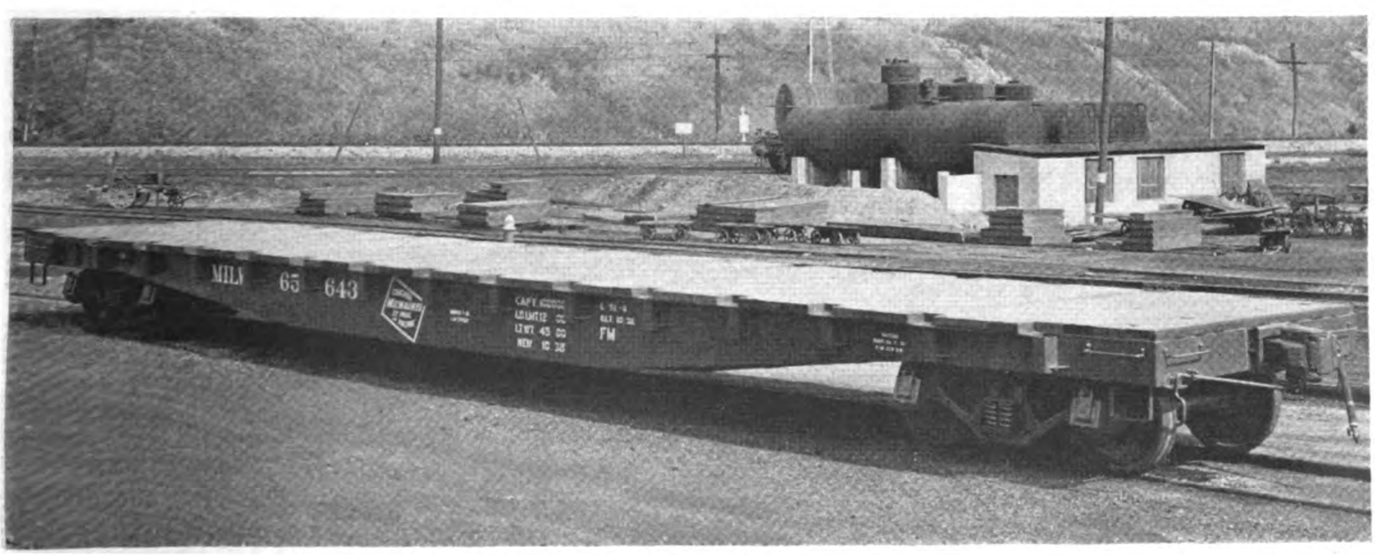
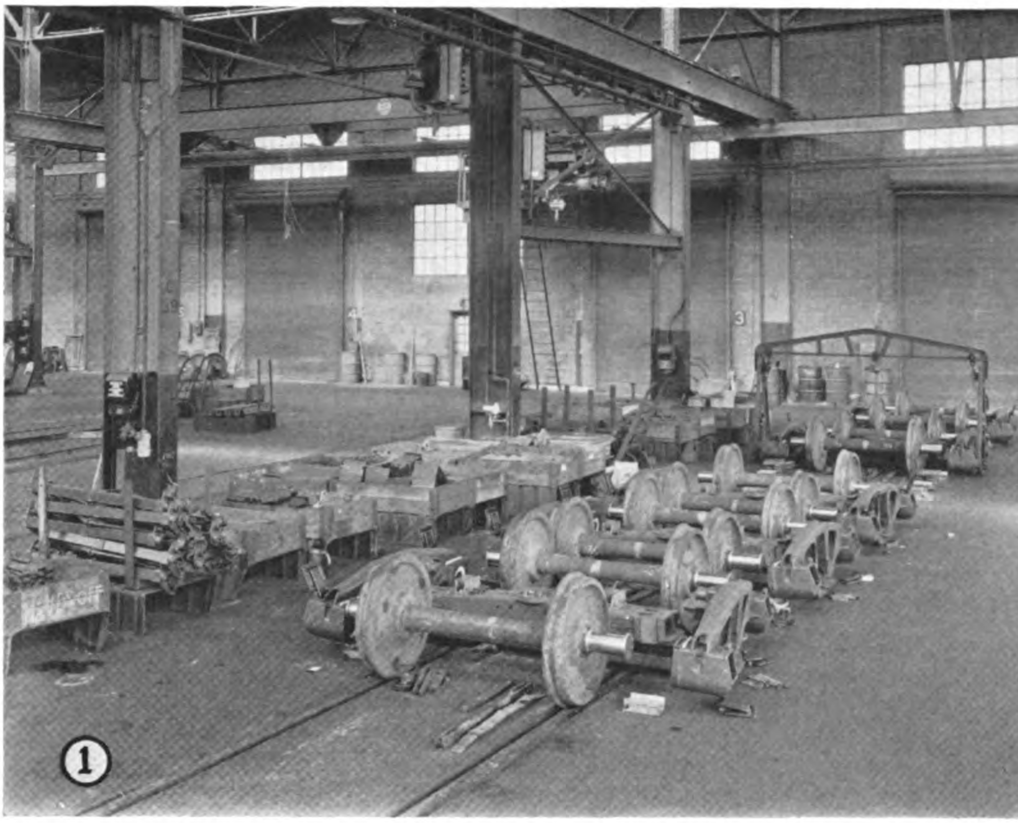
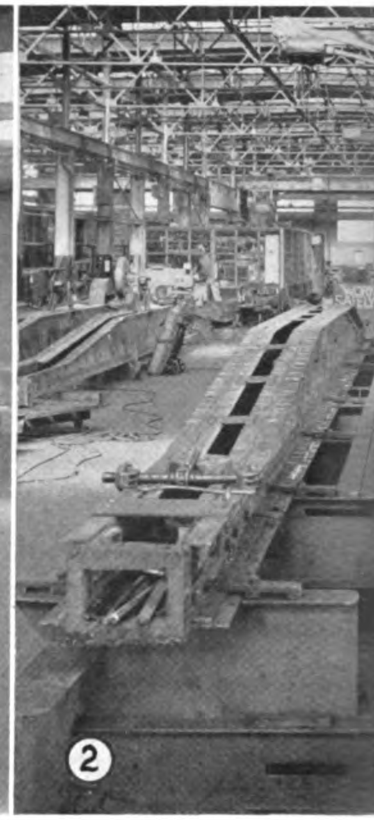


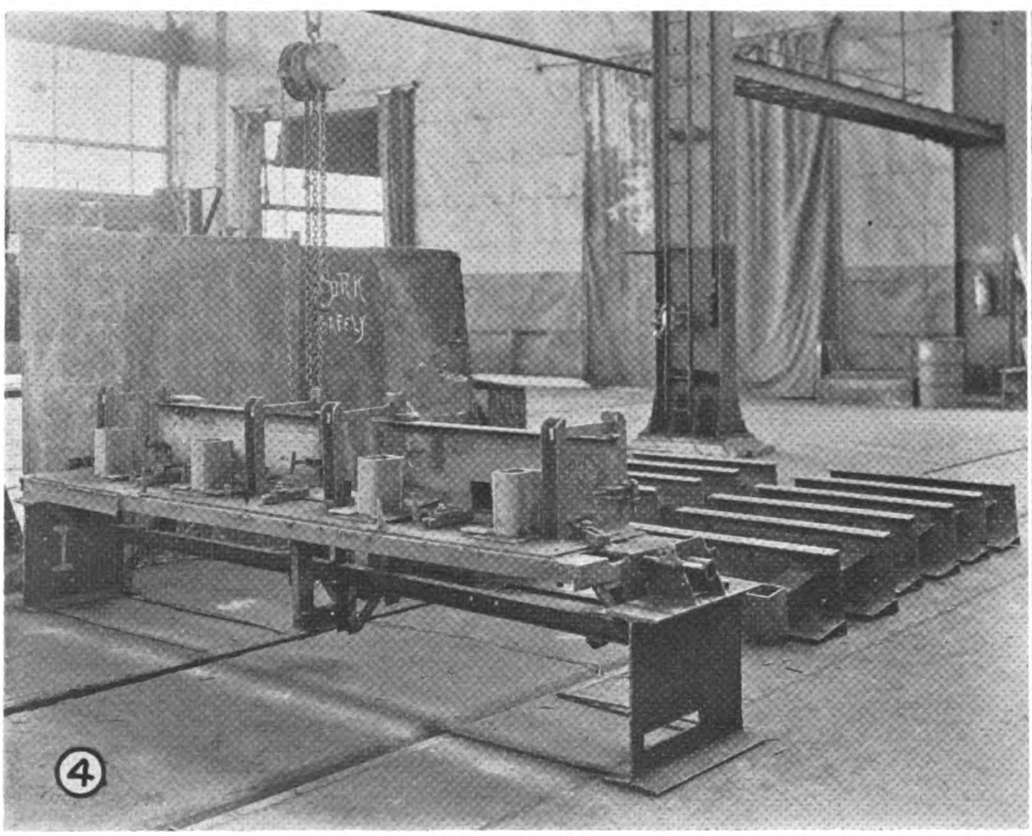
Milwaukee 50-ton flat car just out of the shops

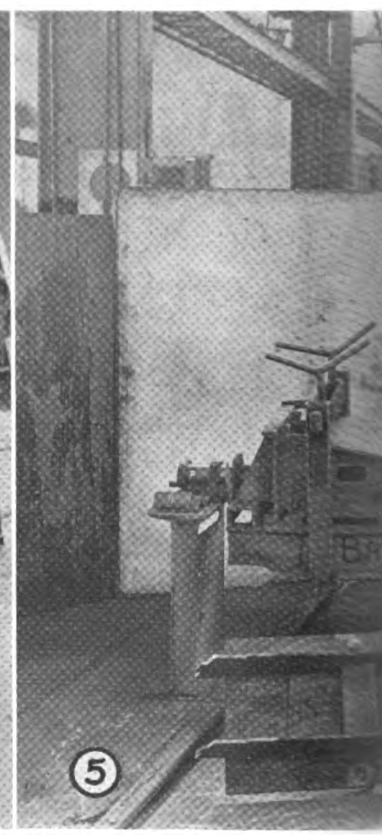


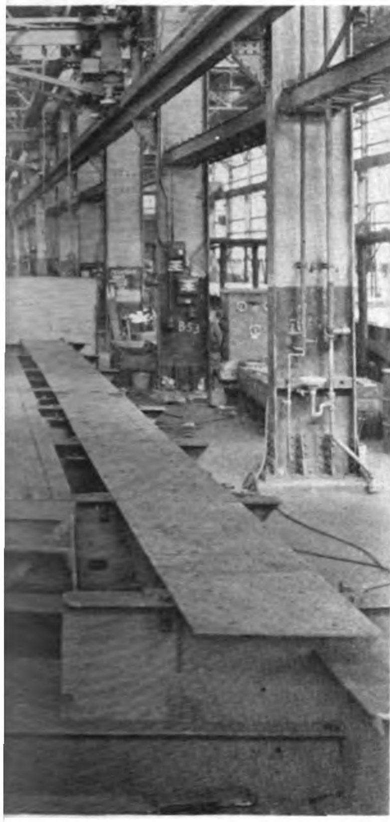


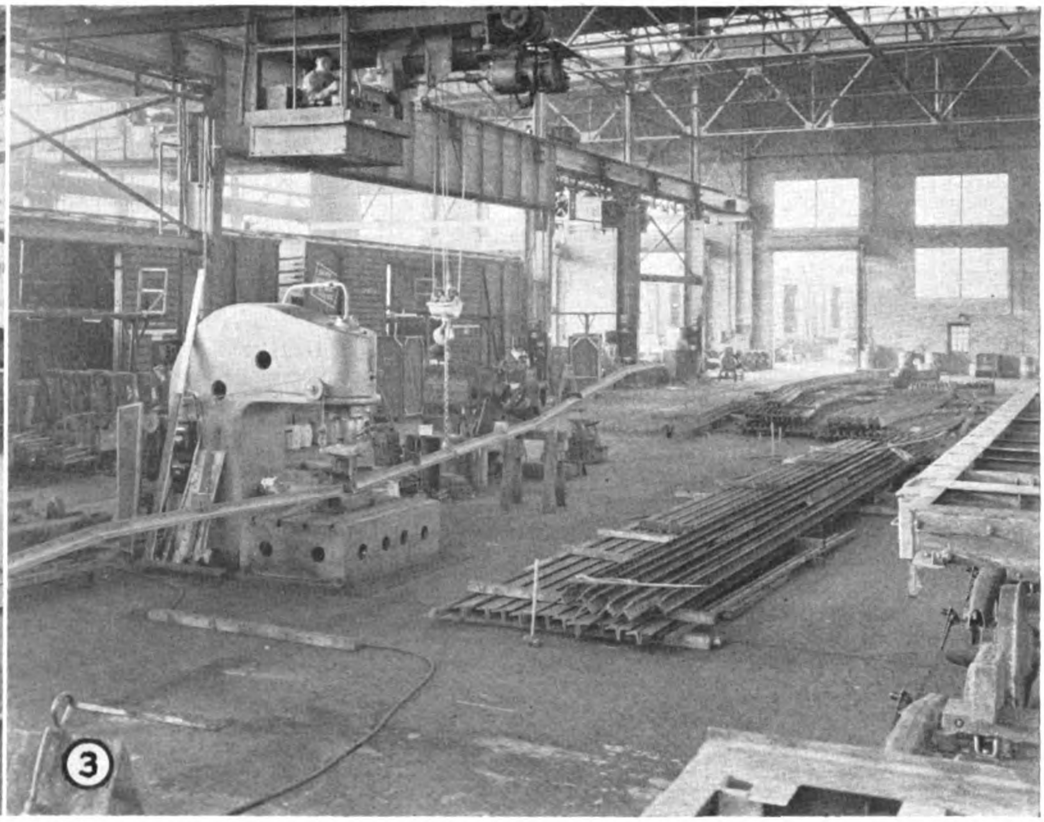
Milwaukee Welded Flat Cars

(1) The trucks are assembled at a location especially equipped for the job. (2) The center sills consist of two sections, each built up on a jig which accommodates two; one being set up while the other is being welded. (3) At this position the chord angles are being formed in a hydraulic press



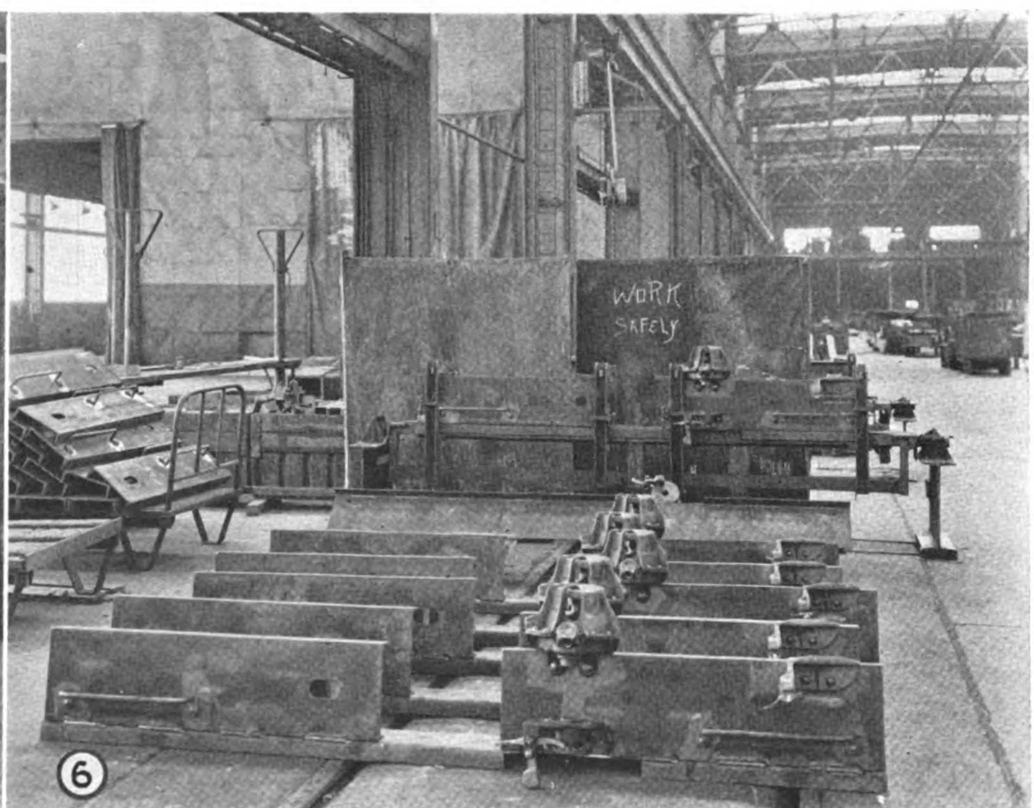


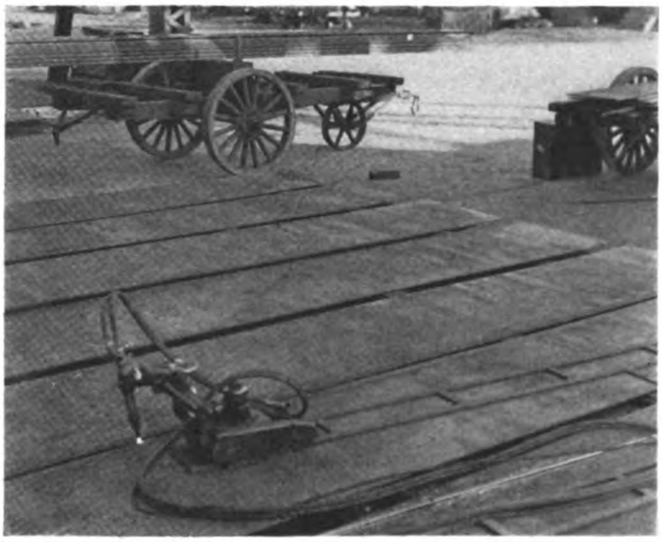




Milwaukee Welded Flat Cars

(4) The end sills are made up of two channels welded to a cover plate. This view shows an A-end sill in the revolving jig. (5) The jig used for fabricating body bolsters is also of the revolving type. (6) A group of B-end sills which have just been removed from the welding jig, shown in the background





Portable flame cutting machine used on tapered sections

Each end sill is composed of two channels which, in turn, are welded to a cover plate. This is accomplished in a revolving jig so that all welding is positioned. Grab irons, uncoupling castings and hand brakes are riveted on by means of a power riveter before the two parts are welded to the cover plate. This eliminates hand riveting and adds to the general efficiency. Separate jigs for the A and the B end sill are provided.

The bolster center-filler casting is a built-up, welded assembly, in which the center-plate casting is welded in place by means of tie-plates which, in turn, are welded to the forged bolster spider sides. This is likewise accomplished in a revolving jig.

The cross-bearers are web plates welded to top and bottom cover plates. Each cross-bearer is assembled in two units on a specially constructed table. One unit consists of a continuous top cover plate, web plate and bottom cover plate while the other has the web plate and bottom cover plate only. In the final assembly the top cover plate passes through slots in the center-sill web plates and is welded in place. The bottom cover plates are welded directly to the center sills and, in order to make them continuous, a tie-plate is welded to the center sills across the lower chord angles.

Each bolster consists of two web plates, one top cover plate and one bottom cover plate. Between the web plates and welded to the bottom cover plate is the H-beam or side-bearing brace. A top cover plate is applied in the main assembly jig. Two revolving jigs are used.

All individual units, having been manufactured, are taken to an assembly jig. The completed center sill is set up with the bolsters, cross-bearers, cross-ties, end sills and side sills and these parts are welded together into a single unit. During the welding operation, the side sills are held in place by means of eight air cylinders—four on each side of the assembly jig. The unit underframe, which is in an upside-down position, is then moved to the next jig where the piping and air-brake parts are applied.

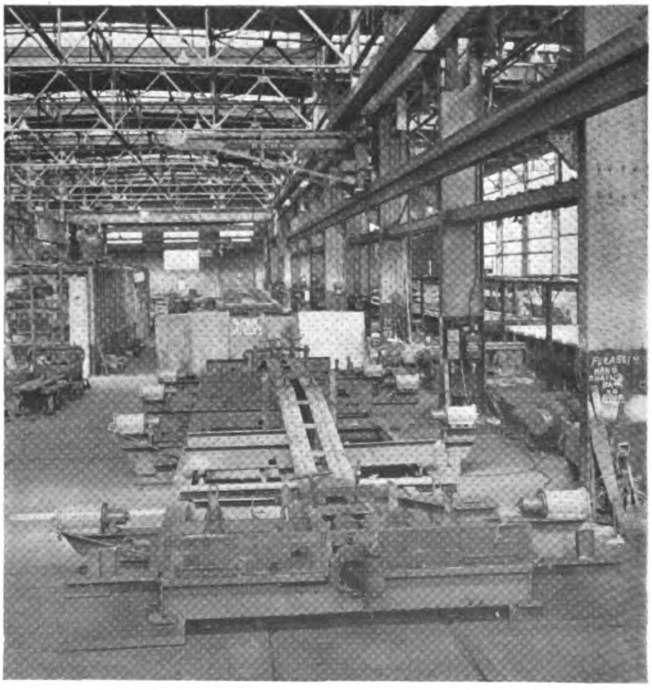
After the welds have been peened and brushed, the car is placed right-side-up; put on trucks, and shunted into the paint booth for the initial priming coat. The latter is a quick drying paint with chromate base. From the paint booth, the car is moved to the adjacent track where car cement, on surfaces having metal and wood contact, floor stringers and boards are applied.

Select common fir is used for floor and stringers, while rough lumber 3 in. by 10 in., with milling sufficient only to surface and square the boards, is used for the flooring. To hold the latter in place there are six ½-in. flat head carriage bolts and four No. 4, 5½-in. long steel wire nails per board. After the floors are applied, the cars are moved to the spray booth where they receive two coats of quick-drying freight-car paint. The final operation is application of the stencils and rigid inspection.

In addition to the usual forged parts manufactured at Milwaukee shops, the following are also locally made: spring planks, spring plates, brake beams, wheels, brake shoes, thrust plates and brake-lever badge plates. The taper section of the web plates on side and center sills is shaped by the use of a portable motor-driven oxy-acetylene cutting machine. The chord angles are cold-formed in a press.

Partial List of Equipment Used on New Milwaukee 50-Ton Flat Cars

Air brakes	Westinghouse Air Brake Co., Wilmerding, Pa.
Brake-beam safety support	Chicago Railway Equipment Co., Chicago
Hand brakes	Superior Hand Brake Co., Chicago
Bottom-rod support	Chicago Railway Equipment Co., Chicago
A.A.R. Type E rotary couplers	Buckeye Steel Castings Co., Columbus, Ohio
Coupler release rigging	Standard Railway Equipment Mfg. Co., Chicago
Cast-steel coupler yokes	Buckeye Steel Castings Co., Columbus, Ohio
Defect-card holder	Apex Railway Products Co., Chicago
Draft gears	Cardwell Westinghouse Co., Chicago Waugh Equipment Co., New York Edgewater Steel Co., Pittsburgh, Pa. National Malleable & Steel Castings Co., Cleveland, Ohio W. H. Miner, Inc., Chicago
Dust guard and closure	Holley Wood Products Corp., Chicago
Journal-box lids	Motor Wheel Corp., Lansing, Mich.
Journal brasses	Magnus Metal Corp., Chicago
Journal wedge	Standard Forgings Corp., Chicago
Side bearing	Edwin S. Woods & Co., Chicago
Side-bearing wedge	American Car & Foundry Co., New York
Truck side frames and bolsters	Bettendorf Company, Bettendorf, Iowa
Barber truck stabilizer	Standard Car Truck Co., Chicago



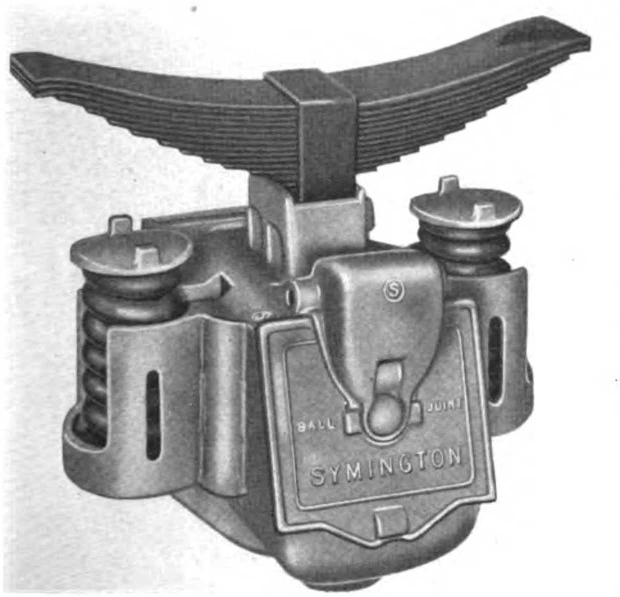
Underframes are assembled upside down

Modified Freight Truck For High-Speed Service

(Continued from page 5)

open space within the side-frame compression and tension members, but all these openings can be closed when specified for more complete protection of the semi-elliptic springs. These springs are entered and removed through the open ends of the side frames, and gasketed covers keep these end openings dust- and water-tight in service.

The side-frame pedestal jaws and the journal-box pedestal ways are contoured as segments of concentric circles, carefully gaged to limits of close clearance. The journal box is, therefore, capable of the same partially rotative movements, between the pedestal jaws as is the bolster and within the columns, thereby making the truck self-aligning throughout and providing the same design essential of full bearing area as is present in the self-aligning column and bolster construction. The pedestal



The ball-joint journal box and parallel spring group

jaws, pedestal ways, column faces and bolster ends may be equipped with hardened liners when specified.

The partial rotation of the journal boxes in response to angular movement of the axles is facilitated by the rocker end mounting of the helical springs, the upper and lower spring caps being contoured to permit an easy rocking motion with minimum frictional resistance to angling and to assist in restoration of the boxes to normal position.

The usual internal box clearances are maintained and (in the absence of lateral axle shock) these permit a limited amount of angling of axle, bearing and wedge without box rotation, but under these conditions only one journal-bearing side lug and one corner of the wedge can be in contact with their respective stops within the journal box. Under simultaneous lateral axle movement, the self-aligning journal box immediately rotates so that both journal-bearing side lugs or both front corners of the wedge are brought into contact with the internal stops, thereby avoiding any battering or breakage of the side lugs, any non-cylindrical wear of the journal-bearing lining or any lift of the bearing to invite waste grabs. The usual flat side pedestal type box is not designed to angle with the axle and such angling as pedestal clearance might permit is not sufficient to protect the bearing against damage from lateral axle thrust.

In the truck herein described proper relative alignment of the two side frames is maintained by means of a pin-connected transverse bottom tie. The side frames may be used without change with a two-piece lateral-motion bolster consisting of a transom bolster supported in the usual manner on the preferred spring groups, and a floating short bolster resting on suitable contoured and geared rockers seated in pockets in the transom bolster. The frames can also be furnished for use with clasp brakes when specified

Standard equipment for this truck includes constant-contact, resilient and non-harmonic side bearings, as the road tests mentioned herein have proved the desirability of bearings of this type to prevent synchronous car-body roll, truck nosing and undue lateral oscillation The first is unavoidable at high speeds with side bearings maintaining the usual clearance. With the type recommended the car body is constantly stabilized but with sufficient resilient yield of the truck bearings to meet all track conditions without danger of derailment.

Anderson Locomotive Spark Eliminator

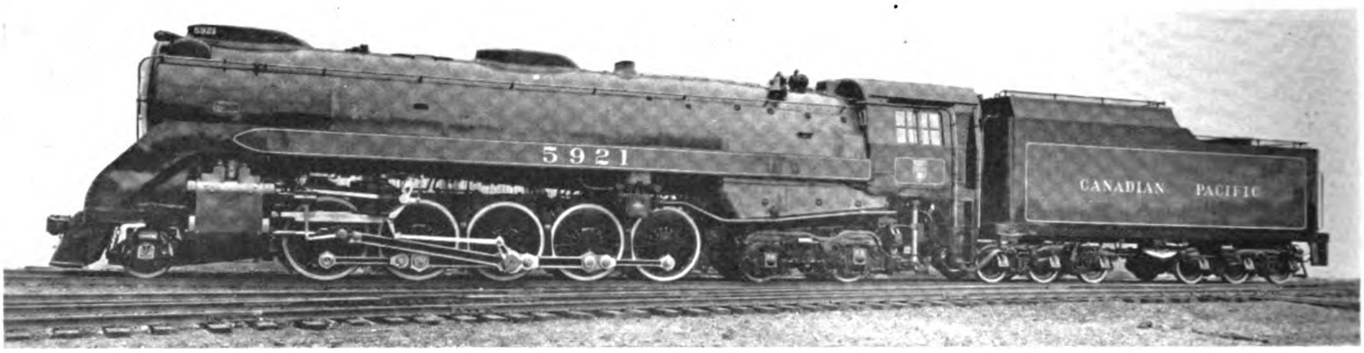
(Continued from page 10)

nozzle areas and larger stacks. In some instances the stack areas are said to have been increased 49 per cent and the nozzle area 30 per cent. This increase in nozzle area is for the same style of nozzle, but when the annular-ported nozzle was substituted, as happened in many instances, the increase was greater than 30 per cent.

Although the application of the Anderson open-type spark eliminator has made a considerable improvement in locomotive performance, the primary effort back of all the experimental work was to reduce the amount of money spent in settling fire claims and fire-loss damages to both railroad and privately owned property. The results obtained in this respect have been highly gratifying. It is reported that, on one division alone, with 535 miles of main line on which the only coal burned is a semi-lignite, the average loss due to fires caused by locomotive sparks was approximately $22,000 per year over about a 10-year period. During the four-year period that the present spark eliminator has been used through this same territory no money has been spent to settle fire claims.

The "Iron Horse" A Heavy Drinker.—Approximately 600 billion gallons of water are required annually to quench the thirst of the "Iron Horse" and for other purposes in connection with the operation of the railroad systems of this country, according to the Association of American Railroads. This quantity of water, the A. A. R. statement says, would be sufficient to meet the needs of the inhabitants of New York City for two years, or a city the size of Washington, D. C., for seventeen years. In volume and weight, the quantity of water used by the railroads each year is greater than all other materials combined. In order to provide the kind of water necessary to meet their needs, the railroads spend approximately $50,000,000 each year. The cost of replacing their 18,000 existing water stations would be in excess of $400,000,000. More than one-half of the water required is used for steam purposes. By the chemical treatment of this water to remove harmful ingredients which cause rust and scale to form on the inside of locomotive boilers, the railroads "have brought about increased safety and efficiency in operation as well as a saving of millions of dollars annually."

1938 Equipment

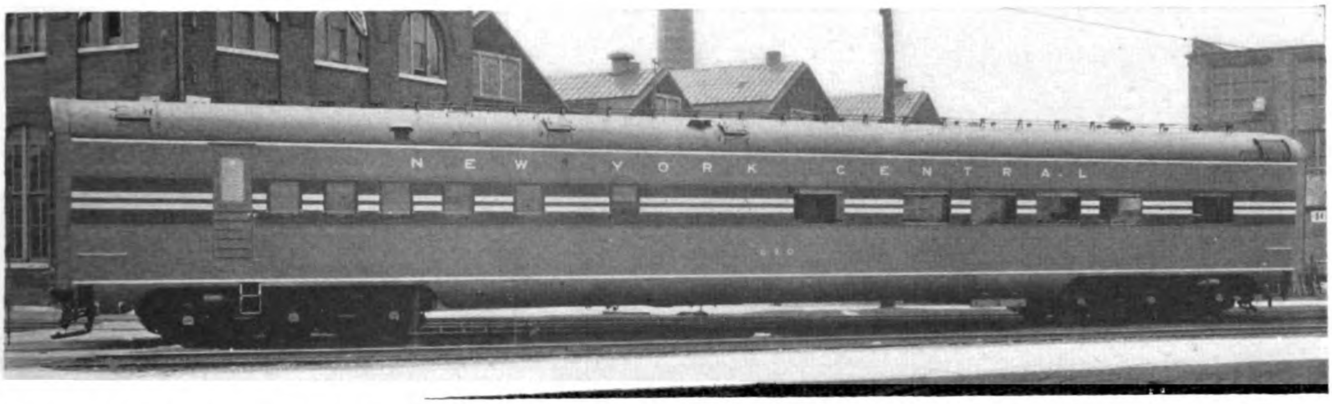


The Canadian Pacific's 2-10-4 type oil-burning locomotives built by the Montreal Locomotive Works for Rocky Mountain service. Tractive force 90,000 lb. Designed to handle 1,050 tons on a 2.2 per cent grade

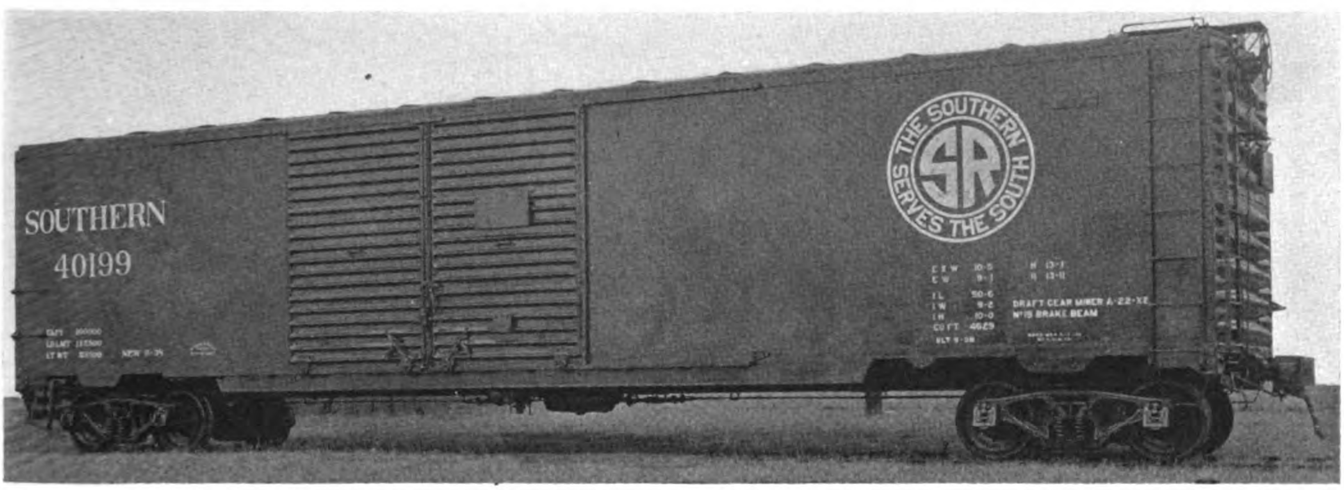
A 900-hp. Diesel-electric switcher built by the American Locomotive Company for the Warrior River Terminal

6,000-hp. Diesel-electric locomotive built for the Seaboard Air Line "Orange Blossom Special" by the Electro Motive Corporation

1938 Equipment



Dining car built by Pullman-Standard Car Manufacturing Company for service on the New York Central "Twentieth Century Limited"—Total weight 134,300 lb.



Furniture car built for the Southern by the Mt. Vernon Car Manufacturing Company

Covered hopper car built for the Continental Carbon Company by the General American Transportation Corporation

1938 Equipment

Light weight deluxe coach built for the New York Central by the Edward G. Budd Manufacturing Co.

50-ton twin-hopper car built for the Canadian Pacific by the National Steel Car Corporation

Six locomotives of this 4-8-2 type were built for fast passenger service on the Grand Trunk Western by the Lima Locomotive Works—the weight of the engine in working order is 382,700 lb. and the tractive force 52,500 lb.

EDITORIALS

Subscribers, Attention!

Another index is now ready for distribution. Subscribers not on our mailing list for the 1937 index are requested to send us their names and addresses promptly if they wish to have this detailed record of the material published in the twelve issues of the *Railway Mechanical Engineer* for 1938.

Significant Changes In Equipment

At the turn of the year it has become customary to pause for a look backward at the course of events during the year that has just closed in order to correct reckonings and, if necessary, reshape a course for the future. In such matters as the design of railway motive power and rolling stock, trends seldom show themselves clearly within the duration of a single year. Looking a little further back, however, significant changes are clearly apparent which are making all equipment—locomotives, passenger cars and freight cars—quite different operating instruments from those which today make up by far the majority of the units in service.

There are three significant factors in these changes. First, is the use of improved materials. This applies not alone to the new structural materials which are going into the building of passenger and freight cars, but to locomotive materials as well. The use of alloy boiler steels has become well established, although far from a majority of the locomotives in service today are fitted with boilers in the construction of which such materials were used. Alloy steels for locomotive forgings have been available for many years. When first applied, however, they were somewhat ahead of the real need for them and also ahead of the standards of practice affecting their handling in the shop. Today, they are coming back into successful use. The higher speeds to which motive power, both for passenger and freight service, is being more and more subjected and the demand for reduced maintenance require the improved physical characteristics of these materials and more intelligence is being applied in dealing with them in the shop.

A second factor, in a measure at least, is related both as cause and effect, to the first. Cars and locomotives are no longer being fitted by 2-ft. rule, but in all working fits tolerances are being reduced until they are becoming more and more of the order established in the automotive industry. Modern American locomotives are no longer being worn out before they run their first mile, and the combination of refinements of design, such as those involved in the use of roller bearings and close tolerances, is beginning to play a definite part in prolonging the service life of motive power particularly and, to some extent, passenger cars also.

Closely related with these two factors is a third—a gradual refinement of shop practice. This perhaps, is less an accomplished fact than the other two factors, and its contribution to improvement in reliability and low maintenance cost is largely to be effected in the future. The use of alloy steels, for instance, demands much more careful handling in the machine shop than has long been tolerated in dealing with carbon-steel parts. Although the better practice will be essential with the alloy materials, it is proving of great value in prolonging the life of carbon-steel parts, the failures of which have been found to result directly from rough treatment. The hammer and chisel era must pass, to be replaced by precision tools and a precision psychology.

The Present Equipment Situation

As the year 1939 gets under way there are many promising signs for much better business than existed during the early part of 1938. The downward trend of general business which began in the fall of 1937 continued until May, 1938, and from that time on there has been a steady improvement in most of the business indices, including railway carloadings and revenues.

With the prospect for a continued increase in the volume of general business activities, at least during the first half of 1939, it is significant that the declining supply of motive power and freight cars is rapidly reaching the point where it provides little reserve capacity to meet increased business. Furthermore, the entire inventory of rolling stock is characterized by high obsolescence.

In the case of locomotives obsolescence has been steadily increasing since the beginning of the depres-

sion in 1930. Although retirements have kept up well, installations of new locomotives have been exceedingly low. In the nine years 1930-38, inclusive, only about 1,900 new locomotives have been added to the inventory. During the same period, however, the retirements have been over 15,500. At the end of 1933 there were 30,500 locomotives—60 per cent of the total—which were 19 years of age or over. Five years later, at the end of 1938, 30,600 locomotives, or 70 per cent of the present total, were 19 years of age or older. Almost one third of all the locomotives are 29 years of age or older. Less than 5 per cent of the present inventory are under 10 years old.

The present supply of freight motive power is probably incapable of successfully handling a volume of traffic as much as 10 per cent higher than that of 1937.

Much the same situation as to age applies to freight cars as has been pointed out with respect to locomotives. For the seven years 1932-38, inclusive, there has been an average of 80,000 freight cars permanently retired from service each year and an average of 22,000 new units acquired. Thus, there has been a steady reduction in the total number of cars, but retirements have scarcely been enough to keep up with the increasing average age of the remainder of the inventory and the new acquisitions at the top have been too small to change the situation appreciably.

The present freight-car supply has reached a point where it is probably adequate to handle a fall peak averaging about 850,000 to 860,000 carloads per week during the highest four weeks' period. This represents an increase of less than four per cent above the peak attained in the fall of 1937. The realization of the narrowing margin of freight-car capacity is indicated by the fact that retirements during 1937 and 1938 have been considerably below the average for the past eight years, amounting to about 69,000 in 1937 and 43,000 last year. Extensive further retirements must be accompanied by replacements of at least as many cars as, and with a continuance of the present traffic prospects many more cars than, the number retired. The incentive for further retirements when there is a restoration of net railway operating income has been increased during the past few years with the gradual establishment of the technique of lightweight construction using high-tensile steels and fabrication by welding. New brakes and developments improving the riding qualities of trucks are also factors which are increasing the obsolescence of the older equipment.

Stream-styled lightweight passenger trains increased during 1938 at an accelerating rate. Thirty-one new trains of such equipment operating on expedited schedules were introduced last year as compared with a total of 54 such trains during the preceding four years. Lightweight cars are also gradually replacing cars of older construction in many other trains.

The demand for artistically finished and decorated passenger-car interiors has been thoroughly established. Few new cars are now built which do not reflect the work of the skilled decorator, in many cases on the exterior as well as on the interior. New methods of lighting, air conditioning, seats designed primarily for the comfort of the occupants and de luxe toilet and lounge facilities are all features of modern passenger-train cars which make the older coaches, many of which are thoroughly sound structures, obsolete from the service standpoint. Rehabilitation projects are restoring some of this older equipment to satisfactory units from the standpoint of the patrons. But all indications point to a steady expansion in the building of cars of light weight, which the new structural materials make possible.

Shop Needs Increase With Better Business

As we look forward to the prospects of railroad operation during the coming year, we are faced with the fact that the demand upon the car and locomotive maintenance facilities will probably increase greatly with the anticipated increase in traffic. In spite of the fact that there has been a substantial increase in car loadings over a period of several months it is true that shop operations as yet have not been stepped up to as great an extent as may seem to be warranted. We have had sufficient experience in this country over a period of ten years with necessarily limited railway repair operations as a result of business depression to know that the economies that are necessary in order to assure the solvency of railroad corporations usually result in conditions that contribute to higher unit costs in the maintenance of equipment. We have long since learned that preventive maintenance is the most economical in the long run, in that it enables a railroad company to keep its motive power and rolling stock in a better average condition. Where intelligent programs of preventive maintenance can be carried out, the unit costs of maintenance—per locomotive- or car-mile, for example—are usually lower than is the case where repair work must, of necessity, be carried on in a more or less hand-to-mouth manner. In locomotive repair work particularly, the cost of maintenance is to a large extent influenced by the relation of the design of motive power to the maintenance problem and to the character of the facilities with which power is maintained.

As a result of the curtailment in purchases of both motive power and shop equipment during 1938, the needs in railroad shop equipment during 1939 are probably going to be more severely evident than they were in 1937 when the volume of traffic exceeded 800,000 cars a week. In view of the fact that the installations of new shop equipment in any one of the last several years, with the possible exception of 1937, have not kept pace with the retirement of obsolete units, there is every indication, as things stand now,

that many roads will find themselves in the position of facing rapidly increasing costs of maintenance operations as the demand for motive power and rolling stock picks up with increasing business.

An analysis of the records of railroad shop equipment purchases during 1938 indicate that there was probably less general buying done of that type of equipment than in any recent year, with the possible exception of 1932. This might satisfactorily be explained on the basis that there was as little, if not less, capital available for the purchase of this type of equipment in 1938 than there was in 1932. There is, however, a significant difference existing in relation to the two years. Because of the fact that up to 1929 and 1930 railway purchases of shop equipment had been of substantial volume for several years, it is reasonable to assume that the average shop was fairly well equipped with machine tools and shop equipment of comparatively modern types as of that date. Beginning with 1932 and continuing up to the present, the purchases of such equipment have been well below normal and many obsolete units have been retired so that it is reasonable to assume that at the end of 1938 the general condition of railway shop equipment as regards suitability for the job at hand is much less favorable than it was at the end of 1932.

Aside from any consideration of the general condition of railway shop equipment, certain things stand out as being of major importance in connection with shop facilities at this time: (1) Continued pressing demands for reductions in operating expenses increase the need for modern repair equipment that will assure low cost operations, (2) there is every evidence of a growing appreciation on the part of mechanical officers and supervisors of the value of modern cost-saving shop equipment as a result of the performance of new installations over the past two or three years, (3) as railway net operating income increases and funds again become available for capital improvements those who are interested in shop equipment must compete with other departments for a share of the money that will be expended and, with better business conditions, the speeding up of industrial and building operations, plus a practically assured broad-scale program of national defense, will undoubtedly make it extremely difficult for the railroad industry to secure new units of shop equipment at a time when it may need them the most.

Those who are responsible for maintenance of equipment operations should not overlook the fact that the prospects for future industrial operations indicate the necessity of competing with other industries, in the matter of price and delivery, for such shop equipment as will surely be needed. Now is the time to lay out comprehensive programs for the replacement of many of the obsolete units still remaining in service and prepare requests for the most important of these replacements early enough in the year to assure that installations can be made in such time that they may contribute to lower maintenance costs during the year.

New Books

Locomotive Cyclopedia. *Compiled and edited by Roy V. Wright and R. C. Augur under the supervision of an Advisory Committee of the Association of American Railroads, Mechanical Division. Published by the Simmons-Boardman Publishing Corporation, 30 Church street, New York. 1232 pages, 9 in. by 12 in., over 2600 illustrations. Price, $5 cloth bound; $7 leather bound.*

The material in the tenth edition of this work is classified in 21 sections, following the same general arrangement as that employed in the last three preceding editions. The first section constitutes the well-known Dictionary of Terms and the others deal with steam locomotives, their various details of construction and special equipment, as well as with electric locomotives, Diesel locomotives and industrial locomotives. The ninth edition was published in 1930. During the eight intervening years tremendous advances have been made in locomotive proportions as well as in the various working parts and construction details. The entire development of roller-bearing driving boxes following the notable installation on the Timken locomotive, which was shown in the preceding edition, has taken place since that edition was printed. Since then the application of roller bearings has extended to the rods as well. Locomotive types on which the four-wheel trailing trucks are used have come to predominate during this same period. In the internal combustion field emphasis has changed from the rail motor car to the locomotive, including road locomotives as well as switch engines. Because of these and other marked changes which have taken place in the last eight years, the material in the tenth edition of the Locomotive Cyclopedia is predominantly new in all sections. A notable change in the new edition has been made in the section dealing with shops and engine terminals. In recent editions of the Locomotive Cyclopedia this section has consisted largely of descriptions of facilities used in the repair of steam locomotives in back shops and enginehouses. In the new edition this section is planned to embrace a general picture of the many phases of locomotive maintenance work needed for reference by those responsible for the conduct of such work. In the 21 chapters of this section has been recorded what has been recognized as modern design and practice. There are 11 chapters which cover the work of the machine shop in detail. Other chapters deal with the forge shop, material handling, and the engine terminal. At the end of the shop section has been added a list of references to articles and reports on shop layout, operation and practice which provides a valuable guide to supplementary information on the several subjects. As a whole, improvements have been made in indexing and the sections and sub-divisions have been somewhat more clearly defined, thus facilitating the convenience of the book as a reference volume.

IN THE BACK SHOP AND ENGINEHOUSE

Gas Burners for The Railroad Shop

Natural and artificial gas can be used for nearly every shop heating operation. In the blacksmith shop gas is used in the large furnaces where scrap is worked into billets and locomotive parts forged. It is frequently used under the boilers in the power house, especially near the gas fields where a low industrial rate is obtainable. Natural gas is used to kindle the fires in coal-burning engines, and has also been used to fire up oil-burning locomotives to working pressure. The fuel lends itself readily to all common shop operations, such as lead and babbitt melting, brass melting, tire heating, preheating all sizes of castings for welding, toolroom tempering (including high-speed steel), lead or cyanide hardening, case hardening, and rivet heating.

The design of gas burners is usually left to the manufacturers, but there are several burners used in shops and enginehouses that are almost impossible to obtain. Manufactured burners are expensive and there is no reason why most of them should not be shop made, but they give poor economy unless properly designed. The burners are of the blue flame or Bunsen type, and require a definite amount of air, called primary air, for mixing with the gas as it enters the burner. The additional air required for combustion is called secondary air and is the air around the flame. This last term is rather loosely used and may be the atmospheric air around the flame or atmospheric air that flows by induction through ports near the end of the burner. There should be an excess of secondary air.

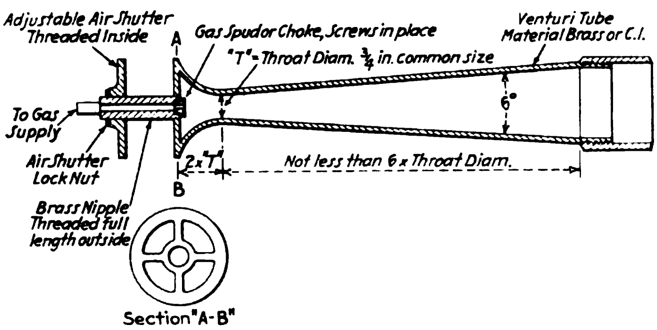


Fig. 1—Atmospheric-pressure gas burner

Atmospheric burners, that is, burners which operate without a compressed-air blast, furnish sufficient heat for melting soft metal, rivet heating and the like. These burners operate on a combination of the Bunsen-burner principle and the injector principle. A tiny jet of gas is used to induce a flow of primary air through a venturi tube, shown in Fig. 1. Gas at line pressure (1 to 10 lb. per sq. in.) discharges from the spud containing a small orifice into the small end of a tapered draw tube or venturi tube. The primary air is entrained by this flow of gas. In the small end of the Venturi tube a vacuum of several inches of water is formed. At the large or burner end of the tube the velocity of the mixture has fallen, but a slight pressure still remains. The principle of this device and the principle of Venturi tubes in general is based on Bernoulli's theorem (the injector principle) governing the flow of fluids through a tube of tapered section. The only function of the tapered injection tube is to utilize the energy of the gas in building up a slight pressure and to provide for air entrainment. The taper of this Venturi tube has an important bearing on the amount of air entrained. A given throat size in a straight pipe will deliver only about one half as much air as a tapered tube.

The ratio of the volume of primary air entrained to the volume of natural gas passed through the orifice is called the entrainment ratio; this varies from 9 : 1 to 12 : 1. Artificial gas requires about half as much air as this. The approximate ratio of burner area to orifice area should be 220 : 1 to 300 : 1. The lower ratios are for gas of low heat value (800 B.t.u.) and the higher ratios are for gas of high value (1,100 B.t.u.). The air shutter is a convenient way of regulating the air-gas ratio from zero to the maximum for which the burner is designed. Only about half the air required for combustion is entrained as primary air. Fig. 1 shows the proportions of an atmospheric injector. The area of the throat is one of the most important dimensions.

Atmospheric Injector Formulas

If v is the velocity of gas flowing through the orifice, m is the mass of gas flowing through the orifice in a unit of time, V is the velocity of the mixture flowing through the cross section of area A, and M is the mass of mixture flowing through the burner in a unit of time, then $MV/mv = C =$ a constant. For all burners geometrically similar but of different size C should have the same value.

The Orifice—The formula for the flow of gas through an orifice under small pressure is:

$$q = aK\sqrt{(h/d)}$$

where q is the quantity of gas passed in a unit of time, a is the area of the orifice, K is an orifice constant of coefficient of discharge that depends on the form of the orifice and the units employed, h is the fall of pressure through the orifice (ordinarily the pressure of the gas above the atmospheric pressure), and d is the specific gravity of the gas referred to air (air equals 1). If the rate of flow be expressed in cubic feet per hour, the area of the orifice a in square inches, and the fall of pressure h in inches of water, then the value of K for a sharp-edged orifice is about 1,000. If the orifice has a conical shape toward the gas supply, the value of K increases to about 1,090 for a 60-deg. cone.

Other (Arbitrary) Formulas.—Let a be the area of the orifice, d the density of the fuel gas, q the volume of gas flowing through the orifice in a unit time, m the mass of gas flowing through the orifice in a unit time, v the velocity of gas flowing through the orifice, A the area of any definite cross section of passage through the burner, D the density of the mixture of gas and primary air, Q the volume of mixture flowing through the burner in a unit time, M the mass of mixture flowing through the burner in unit time, V the velocity of mixture past a cross section of area A, and P, the total port area. The constant ratio of momenta is represented by

$$MV/mv = C = \text{a constant. Also}$$

$$Q/q = \sqrt{(AC)} \times \sqrt{(d/aD)}$$

The arbitrarily chosen cross section A is a constant for a given burner; hence, $\sqrt{(AC)}$ is also a constant and may be represented by K.

Then:

$$Q/q = K\sqrt{(d/aD)}$$

and

$$K = (Q/q)\sqrt{(a\,D/d)}$$

For the purpose of predicting a value of K it is most convenient to take section A through the ports (or outlet of the burner) so that $A = P$, where P is the total port area. Experience has shown that the value of K may be assumed to be $0.8\sqrt{P}$, where P is the total port area in square inches, and the volume delivered is expressed in cubic feet per hour.

The Area of Orifice.—The orifice area can be expressed as

$$a = K^2(d/D)(q/Q)^2$$

In making up burners for shop use, mechanics usually prefer to follow closely the design of some successful burner rather than to calculate a burner from the formulas. Given the required heat value and the characteristics of the gas and the furnace, it is possible for the engineers to calculate the most efficient burner, and it will work successfully without experiment. A drawing of one of the handiest sizes for rivet heating and soft-metal heating is shown in Fig. 1.

Application of Burners to Existing Forges and Furnaces

Atmospheric Burners.—Atmospheric burners can be used in rivet furnaces, and where so used they should be arranged to fire down on the rivets at an angle of 45 deg., as shown in Fig. 2. This prevents chimney action which is to be avoided in a rivet forge for it draws air into the furnace and causes the rivets to scale. The products of combustion are vented through the door opening. An atmospheric burner with $\frac{1}{16}$-in. orifice and 2 in. in diameter at the large end of the Venturi tube will melt 500 lb. of lead in 15 or 20 min. in a crude brick-lined furnace. For lead melting, the burner may fire horizontally near the bottom of the furnace and the flame may impinge on the pot. A better arrangement is to use two burners firing tangentially near the top of the pot and to vent the products of combustion near the bottom, as shown in Fig. 3. This gives a quicker melt. The value of heat insulation is often underestimated by

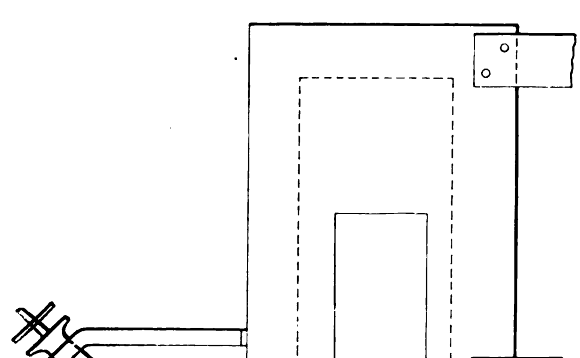


Fig. 2—Application of atmospheric gas burner to a rivet forge

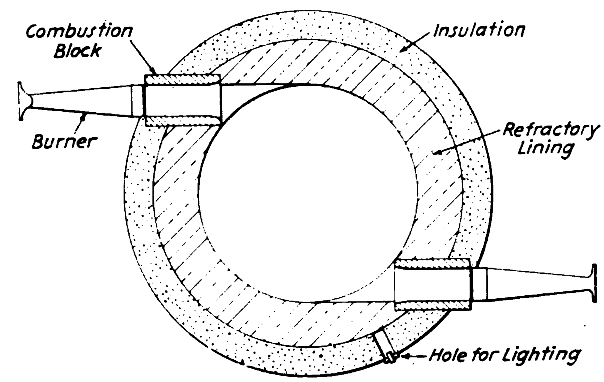


Fig. 3—Pot furnace arranged for tangential firing

practical men, for example, 4½ in. of good insulation like diatomacious earth will save 10 per cent of the fuel in an oven furnace operating at a temperature of 1,500 deg. F. or higher.

Blast Burners.—The blast burner differs from those just described in that a jet of compressed air is used to entrain the gas. The air jet also mingles with the gas as primary air. This type of burner operates on the same principle as a gas blow torch and is hotter than the atmospheric burner; it is used to fire boilers and to melt brass. A gas burner for starting fires in a coal-burning locomotive is shown in Fig. 4. As shown in

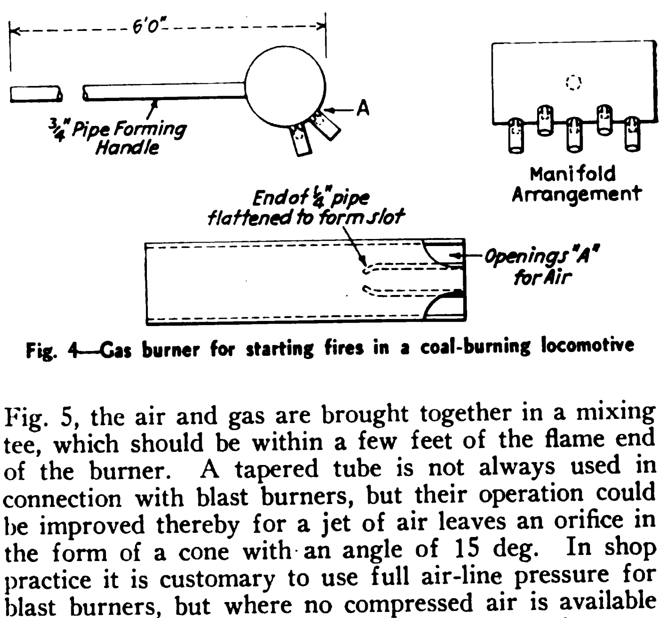
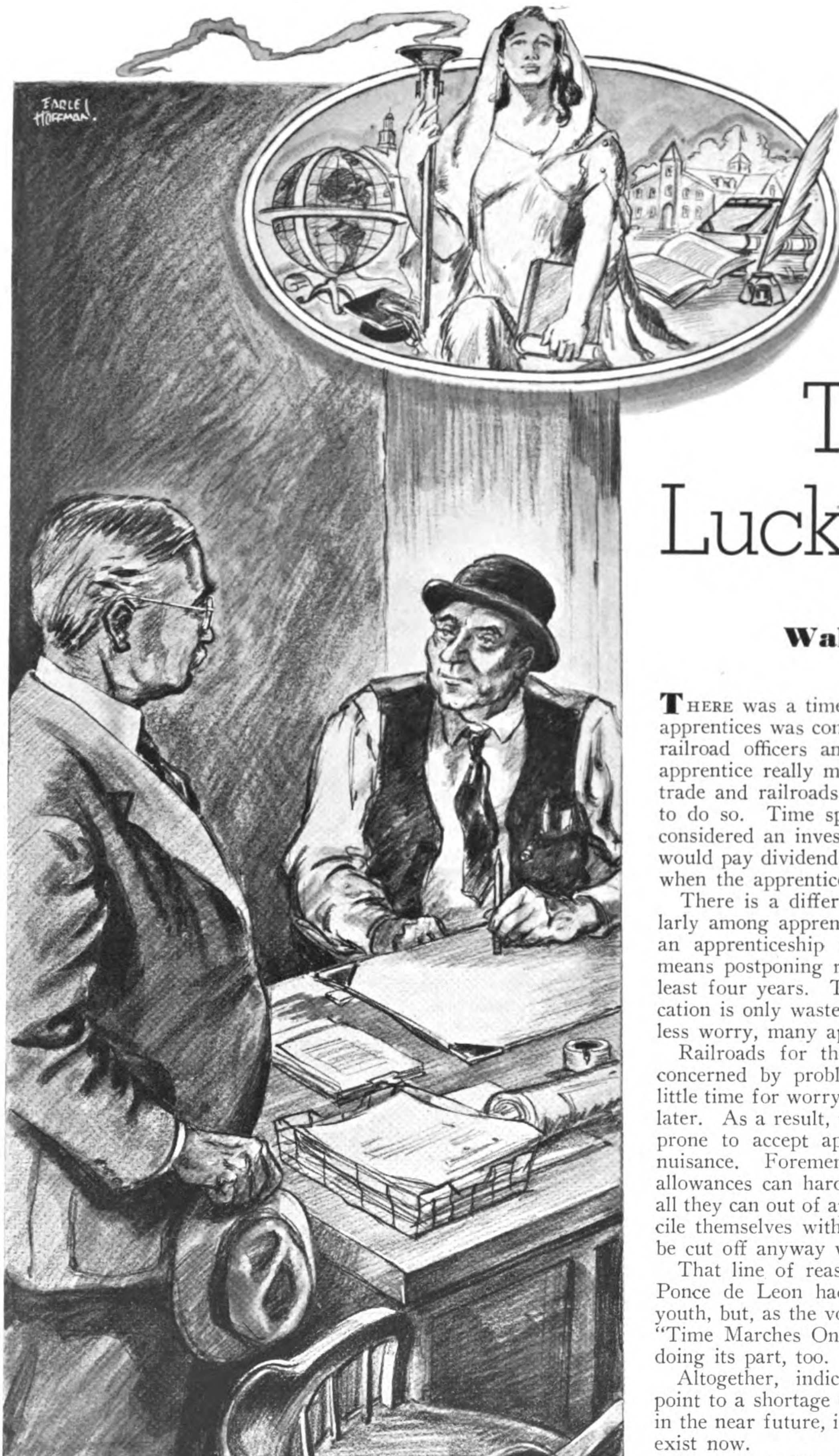


Fig. 4—Gas burner for starting fires in a coal-burning locomotive

Fig. 5, the air and gas are brought together in a mixing tee, which should be within a few feet of the flame end of the burner. A tapered tube is not always used in connection with blast burners, but their operation could be improved thereby for a jet of air leaves an orifice in the form of a cone with an angle of 15 deg. In shop practice it is customary to use full air-line pressure for blast burners, but where no compressed air is available the makers of gas appliances furnish a blower that supplies air at about 2 lb. per sq. in. that gives good results with small burners. When full shop-line pressure is used on a burner it may be necessary to throttle it to prevent blowing out the fire. It may be desirable to place a choke in the air line near the mixing tee so that the air valve will not require careful regulation. The makers of gas appliances furnish a proportional mixer with their blast burners, and part of the primary air is drawn from the atmosphere and mixed with the gas before it is boosted by the inspirator. These burners use only enough compressed air to build up the required pressure. When the gas is induced by compressed air, the pressure on the gas makes little difference and may be from 0 to 10 in. of water without materially affecting the operation of the burner.

The pressure developed in a blast burner is not as high as might be supposed; about 2 lb. per sq. in. is

(*Continued on page 27*)



Evans was figuring what to do next when a short, round-faced man, wearing spectacles with heavy lenses came in

The Lucky Stiff

by

Walt Wyre

THERE was a time when proper training of apprentices was considered very important by railroad officers and apprentices alike. An apprentice really made an effort to learn his trade and railroads gave him an opportunity to do so. Time spent teaching a trade was considered an investment for the future that would pay dividends in more and better work when the apprentice became a mechanic.

There is a different attitude now, particularly among apprentices. In too many cases an apprenticeship is only taken because it means postponing relief or a W.P.A. job at least four years. That being the case, application is only wasted effort and study is useless worry, many apprentices figure.

Railroads for their part being too much concerned by problems of the present have little time for worrying over what might come later. As a result, railroad officers have been prone to accept apprentices as a necessary nuisance. Foremen worrying over reduced allowances can hardly be blamed for getting all they can out of apprentices and they reconcile themselves with the thought that he will be cut off anyway when he finishes his time.

That line of reasoning might be logical if Ponce de Leon had found the fountain of youth, but, as the voice in the news reel says, "Time Marches On." The retirement act is doing its part, too.

Altogether, indications are beginning to point to a shortage of well trained mechanics in the near future, if such a condition doesn't exist now.

Someone in Washington has evidently had his eyes open and seen how things are going, else legislation aimed at correcting the con-

dition would not have been effected. The result is that many states have accepted Federal aid for industrial education. Trade schools, training shops, evening classes and occupational courses have been established in many towns and cities, Plainville being among them.

JIM EVANS, roundhouse foreman for the S. P. & W., was in the office worrying over the work report of the 5082. Engineer Haynes had reported it riding very hard again and Haynes is not one to report something just to keep from wasting the space on the form. There had been half a dozen or more similar reports and as many times work had been done on the engine aimed at correcting the condition.

Spring hangers had been gone over, shoes and wedges had been worked on, weight on drivers had been shifted, and about everything else affecting the riding qualities of a locomotive had been given attention at some time or other.

Evans was figuring what to do next when a short, round-faced man wearing spectacles with heavy lenses came in. "My name is Tate," the stranger said. "I'm supervisor of industrial education. Are you the foreman?"

Evans admitted he was and in a not too cordial tone asked what he could do for him.

The professor explained that there was a possibility of evening classes being organized that might interest some of the men employed in the railroad shops.

"What kind of classes?" Evans asked. "What do they teach?"

"Anything the men might want that would make them more proficient in their work—blueprint reading, mathematics."

"I wish somebody could figure out what's the matter with this engine!" Evans cut in with no intention of being rude.

Tate, somewhat disconcerted by the interruption, stood awkwardly silent for a moment. Then he tried again. "I though perhaps if you would call the men together at noon hour or sometime when it wouldn't interfere with the work I could explain about the school and—"

"O.K.," Evans said. "I'll have a bulletin put up. What day would you like?"

The meeting was called for 12:30 the next day in the machine shop. Evans, absorbed by matters of more immediate importance, told the clerk to put up a bulletin and forgot about it.

Next day the professor was in the machine shop at 12:25 practically alone. Two or three men that brought lunches were sitting on a bench in the warm corner of the shop. They paid no attention to the professor.

Tate stood around in the shop looking as much out of place as a man at a meeting of the Ladies Aid and feeling more so. He was just about ready to give it up as a bad job when the men began to come in almost in a bunch, but the foreman wasn't among them.

The men seated themselves around on work benches, driving boxes and anything else convenient. Most of them, somewhat peeved at having part of their noon hour disturbed wore a disgruntled let's-get-it-over-with air.

Tate nervously polished his glasses and waited for the foreman while the men fidgeted impatiently.

Finally deciding that it was up to him, the professor opened the meeting. He explained what was being done and told them about the proposed classes. "Now are there any questions?" he asked.

"If it would give me enough seniority to hold a job when I finish my time, I'd take it," Sam Ragan, a machinist apprentice, said to no one in particular.

"It won't do that," Tate replied. "But it might help you to hold a job if you get one." The professor was little provoked at the lack of interest.

Seven men put down their names as prospective students. Of the group, Jack Caldwell was a machinist apprentice. Ragan and Roy Miller, the other two apprentices, didn't figure it was worth the effort.

Other men agreed it was a good thing, but for various reasons they wouldn't attend.

EVANS, still concerned over the 5082 and a thousand and one daily problems, didn't even know any further attempt was being made to organize a class. Tate felt that the foreman was to say the least not interested and didn't approach Evans again.

If Jack Caldwell had not been interested as he was, the class would not have been organized. After trying unsuccessfully to get more men in the roundhouse interested, he got enough to sign from contract shops in town, and the class was started with the minimum number of twelve. Practical shop mathematics was the subject they elected to take, two nights a week for twelve weeks.

All of the seven that attended the class from the roundhouse were interested, but young Caldwell was most interested. Each noon hour he could be seen off in a corner alone working out problems from the book or applying rules he had learned to problems he found in the shop. The other two apprentices kidded Caldwell a lot at first, but he ignored them and they soon quit.

One day Caldwell got even for the kidding in a practical way. A piece of steel shafting four inches in diameter, thirty feet long was shipped in to have some machine work done on it. At noon hour the men congregated around the shaft guessing at its weight.

"It'll weigh over a ton," Sam Ragan said confidently.

"Yeah, and then some!" Roy Miller said. "The schoolboy should be able to tell us what it weighs," he added pointing to Caldwell.

"Well, I don't know." Caldwell was doing some figuring in his head.

"Bet you five dollars I can guess closer than you can," Ragan said, meaning it as a bluff.

"I'd rather not bet on it," Caldwell demurred.

"And I'll make it another five!" Miller chipped in, bluffing too.

"All right!" Caldwell snapped. "Put up your money!" He pulled out a ten-dollar bill and handed it to Cox, a machinist, standing nearby. "We'll each write our guess on a slip of paper and hand it to Cox. Then he can get the weight from the storekeeper. The one nearest gets the money."

Miller and Ragan would have backed out of the bet, but the others started kidding them.

"All right, here's mine!" Young Caldwell wrote some figures on a piece of paper.

Ragan wanted to stall a while trying to figure the weight, but Machinist Cox wouldn't let him. "You started this; now back up your bluff " Cox said.

Ragan and Miller exchanged glances. Then Miller said, "Let me have your pencil."

"No framing up," Cox warned them.

"Oh let them go ahead," Caldwell said.

Cox opened the three guesses. Ragan estimated the piece to weigh 1950 pounds; Miller, 2275; Caldwell had down 1270 pounds.

The crowd rushed to the storeroom. "It is billed at 1280 pounds," the storekeeper said. "That might be ten or fifteen pounds off."

Then Ragan got mad. "You saw the bill!" he accused Caldwell.

"No, I never saw the bill, but I wasn't guessing—

much. I've learned a short method of figuring the weight of iron that is pretty close."

Cox handed over the two fives and a ten. "Wish you would tell me how you figured that weight; it might come in handy some time."

"Well, it's mighty simple. Thirty-six cubic inches of wrought iron weighs almost exactly ten pounds. So all you do is get the area of the end section in square inches, then multiply that by ten pounds for every yard, or three and one-third pounds per foot.

"In this case it would be 4 x 4 x .7854 for the area of the end. Multiply that by ten times ten figures about 1257. Steel is a little heavier than wrought iron, so I added a few pounds to it."

"Believe I'll start going to school," Cox commented.

In the meantime, Evans, like most other roundhouse foremen, was having troubles of his own. He finally corrected the rough riding of the 5082. He corrected it not by doing one thing, but several. The engine had just about shook herself to pieces; driving boxes were in bad shape, pins out of round, and the journals needed truing. He ran the engine over the drop-pit and went over it from pilot beam to draw.

Other things came up to occupy his mind, though, and he paid no attention to the class that was going on. He had, in fact, dismissed it entirely from his mind until one day he had a request from the superintendent to build an oil tank for a weed burner. The tank was to be round, hold 100 gallons, and be 5 ft. long. Evans turned the job over to Henry Barton, a boilermaker.

Barton scratched his head trying to remember the rule for figuring it and couldn't. The other boilermakers couldn't either. Barton went to the foreman. After using up half a pad of clip, Evans told the boilermaker to take it to somebody else.

After trying several mechanics, Barton gave the problem to Caldwell. The apprentice figured it in a very few minutes.

"Did you get the tank figured?" Evans asked Barton later on.

"Yeah, had to get an apprentice to figure it. Seems like a lot of us could get something out of that school!"

After the holiday season was over, business fell off as usual and the S. P. & W. appropriations were reduced. Evans had no alternative but to cut forces. It was a bad time for apprentices to come out of their time, but it worked out that way. Ragan and Miller finished the first part of January and managed to get a few days extra work in place of men laying off. Caldwell finished in March and there wasn't any one laying off.

About that time the railroad decided to build some much needed treating plants, the largest at Plainville. Sanford was to be the next largest with several smaller automatic plants along the line. The same contractor obtained contracts for both the one at Plainville and the one at Sanford.

Work started on the one at Plainville the first of April. Before work started, the foreman in charge came to Plainville to make preparations. "I'm going to need half a dozen or so laborers when the work gets started and I could use two or three what I call handy men. Not necessarily mechanics, but fellows that know something about using tools."

Evans told the foreman, Darnall by name, about the three apprentices that had been cut off. "If you need any figuring, Caldwell is pretty good, they say," Evans added.

Evans sent word to the three men that they might get jobs with the contractor and to go see him.

All three immediately rushed down to call on Darnall.

"Well, to tell you men the truth, I haven't had much luck with railroad mechanics," Darnall said. "Railroad work is different from most other jobs. I won't need you men until Monday," he added. "Report then and I believe I can give you jobs. The pay may not be quite as good as you've been getting, but," Darnall smiled, "I'll try to pay you what you are worth on the job."

The three men started to leave when the foreman stopped them. "I might be able to use one of you the rest of the week. I've got a lot of figuring to do, material to order, and so on." Darnall scratched his head. "All three of you look like pretty intelligent men. If you don't mind, I'll just give you each a little problem I was figuring when you came up. Here, sit down."

The foreman made room for the three to sit at an improvised desk and handed them paper and pencils. "Part of the job is a round sump tank twelve feet deep, sixty feet in diameter. It will be set in the ground four feet deep. It will be built of cement sixteen inches thick. How many yards of dirt will have to be moved and how many yards of concrete will be required for the job? I might add how many feet of lumber will be needed for building the form, but guess that would be too much."

Caldwell started figuring. Ragan and Miller fidgeted nervously and chewed the ends of their pencils.

"I don't believe I could figure it right off-handed," Ragan said.

"Me neither," Miller said. "It's been quite a while since I went to school." He cast a sneering glare towards Caldwell, who already had figured the cubic yards of dirt to be moved.

"Well, boys, come back Monday," Darnall told them. Then to Caldwell, "Looks like you win the job by default. I believe you are the man Evans told me about."

"Thanks," Caldwell said without looking up from his figuring.

"Lucky stiff," Ragan said as the two walked away.

"Damned hand shaker," Miller chimed in.

Darnall said something about going to town a few minutes and left young Caldwell alone with his figuring.

Caldwell finished figuring the job and checked his figures carefully to see that he had made no mistake. The foreman had not returned, so Caldwell figured the amount of lumber required for the form. He didn't know how the form was to be braced, he could only guess at that.

That finished and with nothing else to do, he started looking over blue-prints of the job. The foreman stayed away over an hour and Caldwell had time to look the prints over pretty well. He was studying the piping when he came to a place where two six-inch pipes joined a ten-inch pipe. He was not familiar enough with the work to know just what was to be done, but it didn't look right. While he was pondering over it, Darnall returned.

"Well, did you figure it out?" the foreman asked.

"Yes, sir, and for lack of something better I was looking over the prints."

"Did you find anything wrong with them?" Darnall asked jokingly.

"Well, I don't know," Caldwell said hesitatingly.

"What do you mean don't know?"

"Right here," Caldwell pointed at the print, "where two six-inch pipes join a ten. I didn't know whether the combined volumes should equal the one or not."

Darnall looked at the print. "Well, I'll be damned! Somebody else might have caught it and they might not. It could have caused a lot of trouble." The foreman picked up a pen, dipped it in white ink and started to write. "What size should they be?" he asked.

"If one of them was an eight-inch pipe and the other a six, they would carry as much together as the one ten-inch."

"This one should be an eight. It's supposed to carry almost twice as much as the other." Darnall made the corrections on the print.

MILLER and Ragan went to work Monday morning. They were assigned jobs that might be classed as helpers' work with a corresponding rate of pay. It galled them terribly to see Caldwell on an easier job and with a better rate of pay. What hurt them most of all was to see the younger mechanic carrying a roll of blue-prints and checking work done by them.

The job lasted four months. Ragan and Miller stayed at the same job they started with until it was finished. Each had threatened privately to quit several times, but the pay was better than WPA jobs offered, so they stuck.

After the job was completed, Darnall told Caldwell to stick around a few days and see that everything operated O. K. "There's always a few bugs in a new plant," he added.

"How long do you want me to watch it?" Caldwell asked.

"Oh, two or three days."

"What will I do then?"

"Why, come to Sanford soon as you can. We're starting work there," Darnall grinned, "and being as it's away from home I might be talked into giving you a little more money."

"Thanks a lot, Mr. Darnall."

"Oh, hell, don't thank me; thank yourself for trying to learn something."

The foreman went to the roundhouse office to tell Evans goodbye. "And," he added, "I'm taking young Caldwell along with me. If the railroad doesn't need men like him, we do!"

"Lucky stiff!" Miller snorted when he heard about it.

Gas Burners for The Railroad Shop

(*Continued from page 23*)

probably the maximum. The flame end of the burner should have a number of small holes $\frac{1}{32}$ in. to $\frac{3}{32}$ in. in diameter. If an attempt were made to burn the mixture at the end of the unobstructed pipe, it would blow out. In a furnace, however, the gas will burn against the brick wall several inches from the end of an unobstructed pipe—a sort of surface combustion.

If an attempt were made to burn natural gas without mixing it with primary air it would burn with a long lazy flame tinged with yellow. When the air blast is turned on it sharpens up and turns blue, and the temperature of the flame is increased. The air blast causes the flame to burn with a sharp roar that would be objectionable for some domestic use. Regarding the burner it may be said that the smaller and more numerous the ports the better will be the characteristics of the burner. On account of the difficulty and expense of drilling many small holes the possibilities of improvement along this line are limited.

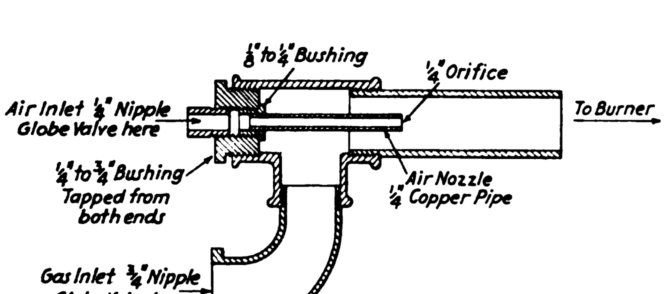


Fig. 5—Combination mixing tee and inspirator for gas blast burner

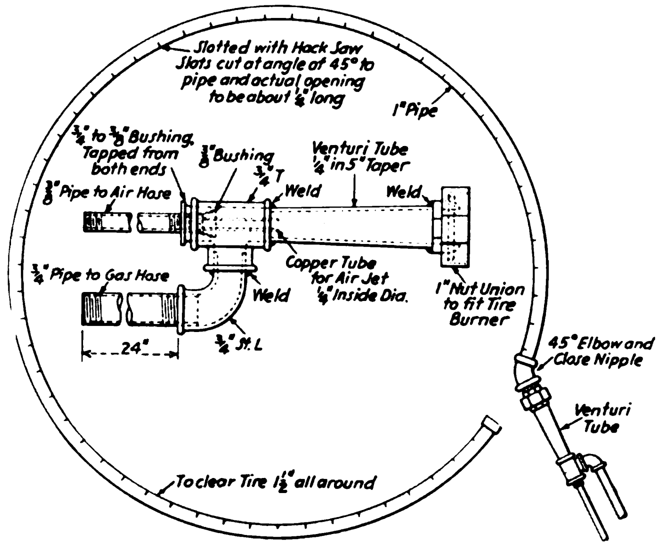


Fig. 6—Tire heater for burning gas, showing details of the air injector and the gas mixing tee

If the holes are made small enough, conditions approximating "surface combustion" will be obtained. This is the combustion of an air-gas mixture within a porous medium without flame. The porous material becomes incandescent and an intense heat is produced with a small consumption of gas. Such a plan has been tried for heating lead pots. The furnace is packed with porous refractory material filling all the space between the sides of the furnace and the pot. The air-gas mixture is introduced through a number of small pipes near the bottom to give an even distribution and prevent backfiring.

Tire Heaters

Tire heaters have been developed which operate very efficiently using gasoline, distillate, or kerosene as a fuel. The same burners do not work very well using gas as a fuel; however, by drilling more holes in the burners about $\frac{1}{16}$ in. in diameter and 2 in. apart, fair results with the burners will be obtained. Gas burners work better if made out of larger pipe than is commonly used for burning vaporized liquid fuel; $\frac{1}{2}$-in. pipe is used commonly, but 1-in. or $1\frac{1}{4}$-in. pipe is better for gas burners. It might be supposed that if the mixture supplying the burner flows through a $\frac{1}{2}$-in. pipe nothing would be gained by using a tire hoop made from pipe of larger diameter. Experience and the laws of physics governing the flow of fluids through tubes of varying section show that a considerable pressure is built up in the larger pipe, which therefore makes a better tire heater. It is desirable to place these tire heaters on the wheels of locomotives in the enginehouse without removing the brake shoe or raising the wheels more than 1 in. above the rail; thus, a $\frac{3}{4}$-in. pipe is about as large as can be used here. For backshop use, where the wheels are removed from the engine, larger sizes of pipe may be used for burners. Some efficient tire heaters have been made from $1\frac{1}{4}$ in. pipe perforated every 3-in. by sawing slots crossways with a hack saw, as shown in Fig. 6. The openings in the pipe should be about $\frac{1}{4}$

in. long. An air blast is always used for tire heating. Heaters using distillate or kerosene have a double coil with a return bend, the first being used to preheat the mixture. This double coil is not necessary when gas or gasoline is used as fuel. In changing over this type of burner for use with gas, they work well if both coils are drilled.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Computing Tube-Sheet Braces

Q.—Kindly furnish me with the necessary information for computing the front tube-sheet braces of a locomotive boiler.—F. H.

A.—The area of the back or front tube sheet to be stayed shall be the area enclosed by lines drawn 2 in. from the outside of the tubes or the center of a row of stays and at a distance D from the shell or wrapper sheet. The area of dry-pipe hole in the front tube sheet should be omitted from the area as obtained above since it is assumed that this area is supported by the dry-pipe fastenings and superheater header.

The value of D used may be the larger of the following values:

(1) $D =$ The outer radius of the flange, not exceeding eight times the thickness of the back head or front tube sheet.

(2)

$$D = \frac{5 \times T}{P}$$

where $D =$ unstayed distance from shell or wrapper sheet in inches, $T =$ thickness of back head or front tube sheet in sixteenths of an inch, and $P =$ maximum allowable working pressure in pounds per square inch.

When the back or front tube sheet is supported with both gusset and rod braces, the stress on the rod braces should be calculated separately from the gusset braces.

In calculating stresses on braces and their attachments, the angularity of the brace, if in excess of 15 deg., must be taken into consideration. The practice in calculating stresses on braces is to take the product of the entire area supported by either the rod or gusset braces and the boiler pressure and divide this product by the sum of the least cross-sectional area of all the rod or gusset braces.

This method should be followed, providing the braces are uniformly spaced. If one or more of the braces are so segregated as to receive more than their portion of the load, they must be calculated separately from the rest.

In taking into account the angularity of the braces, the angle of each brace must be found and its sectional area must be reduced in proportion to the angle that the stay makes with a line drawn at right angle to the surface supported, as explained in the following paragraphs. This is to be done in preference to increasing the load in proportion to the angularity of the brace so as to avoid the necessity of calculating the area supported by each individual brace.

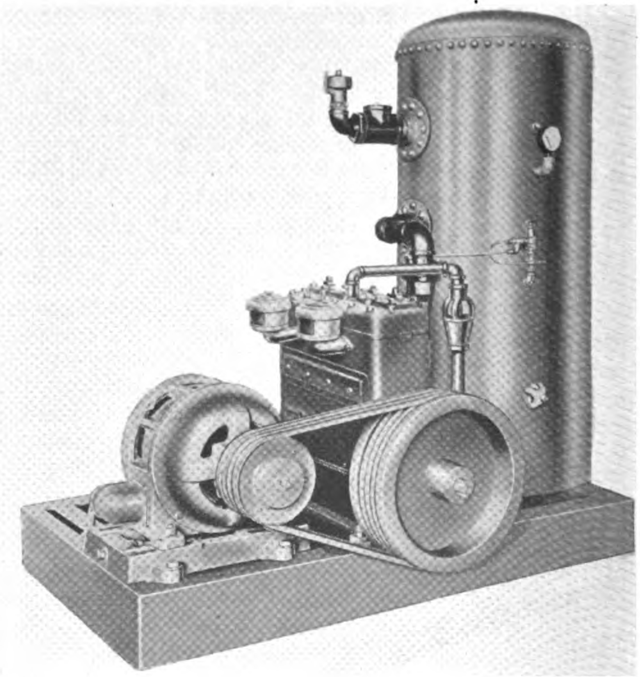
The angle of each brace must be ascertained and, if in excess of 15 deg. the area of the brace must be reduced by multiplying the area of brace by the cosine of the angle that the brace makes with a line drawn at right angles to the area supported.

The line representing the angle of the braces shall be the center line of a rod brace, and on gusset braces the center line shall be a line intersecting the front rivet in the flange where it is riveted to the wrapper sheet and the bottom bolt in the back-head angle irons where the gusset plate fastens to the angle irons.

Compact Stationary Air Compressors

The illustration shows an adaption of the Schramm Utility stationary compressors for belt drive as now offered by Schramm, Inc., West Chester, Pa., in 120-, 150-, 230-, 300-, 380-, 450- and 600-cu. ft. sizes. The features of the complete assembly include compact dimensions because of the modern, straightline compressor design, together with short vee-belt drive and vertical air receiver. These elements have been assembled into a complete plant, mounted on a single-frame base to occupy minimum floor space. Smooth performance of the compressor makes it unnecessary to provide any special foundation, the base supplied serving as the compressor's own foundation.

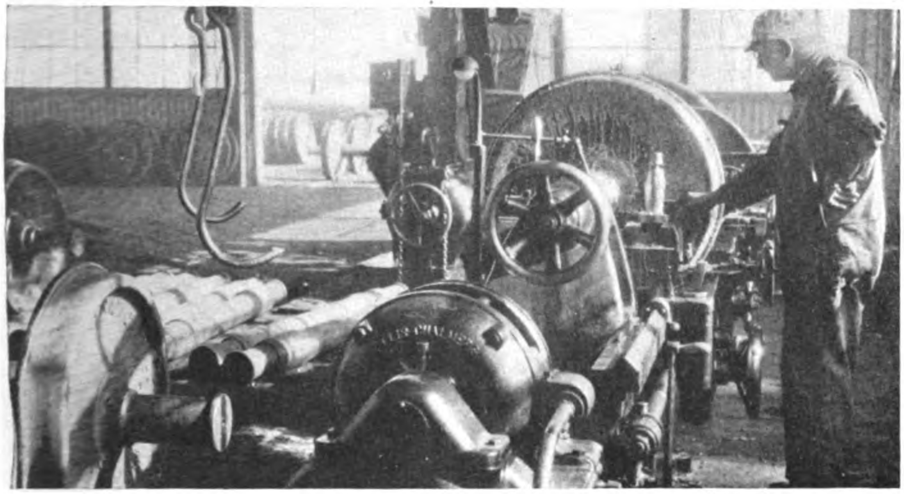
Another economy is introduced by the adoption of 1,800-r. p. m. motors for driving the compressors. The compressor unit itself includes such mechanical features as force-feed lubrication, mechanically operated intake valve, discharge valve occupying fullhead area, smaller and lighter moving parts, and thorough cooling by water.



Schramm Utility belt-driven compressors designed to occupy minimum floor space

With the Car Foremen and Inspectors

Wheel Shop Observations*



By H. F. Ripken

THE enormous cost of applying or replacing approximately a million pairs of car wheels per year in the United States and Canada, along with the even greater cost resulting if not replaced at the proper time, makes wheels and axles probably the greatest problem of railway maintenance.

One thing observed lately is that, since the removal of the rule that permitted through-chill wheels to remain in service until down $\frac{1}{16}$ in. in 12, fewer broken wheels are received at the wheel shop. It is not unusual for the shop inspection to find wheels broken or starting to break up where the through-chill spot is just starting down, and considerably less than $\frac{1}{16}$ in. within a radius of 12 in.

Observations and shop inspection of broken and cracked chilled-iron wheels indicate that the through-chill wheel that has started to give or go down is probably the most dangerous wheel in service. With the present higher and constantly increasing speed of freight service, a heavily-loaded car plus a wheel with a through-chill spot is a mighty poor combination and one that should be eliminated by the removal of the wheel from service as soon as possible after there are indications of the spot becoming low.

Uniform Wheel Hardness Sometimes Lacking

Another observation is that, while many advances have been made in wheel design and structure, there is still an apparent lack of uniform hardness or wearing quality in the tread of too large a percentage of wheels and tires; this, regardless of type or whether they are cast-iron, cast-steel, rolled-steel, and one- or multiple-wear wheels or steel tires. This apparent lack of uniform hardness is shown by the uneven tread wear found on wheels removed for other causes and long before they take the tread-wear gage. This is revealed as such wheels pass through the wheel and journal lathes in the shop.

An illustration of this in cast-iron wheels was brought out recently at our shop. Seventy-five pairs of 60,000-lb. capacity cast-iron car wheels were selected after a hand inspection of two hundred pairs of O. K. second-hand wheels removed from dismantled cars. These wheels were run through the mounted-wheel journal lathe in order to obtain wheels with true running treads for caboose service. Of the seventy-five pairs, only four pairs, or a little over five per cent, were found to run within $\frac{1}{32}$ in. of true, and this from uneven wear and not improper boring. None of the 200 pairs from which these wheels were culled out had over $\frac{1}{8}$ in. tread wear.

It is known from experience that a low spot of $\frac{1}{32}$ in. in 12 in. on a 33-in. or 36-in. wheel will pound to such an extent as to cause hot boxes on engine-truck wheels under locomotives in high-speed service. This illustrates the blows that wheels developing uneven tread wear must administer to road bed and truck and, to an even greater extent, to the superstructure of locomotives or cars and the merchandise with which the car is loaded. The resulting maintenance and damage to loading will grow enormously as train speed increases, as it is now doing, unless this condition is improved.

Low Spots Developed by Rolling Action

As engine trucks are not equipped with air brakes, the low spots are developed from rolling action only, confirming opinions that such low spots, or unequal tread

* Excerpts from a paper presented at the December 5 meeting of the Northwest Carmen's Association by H. F. Ripken, wheel shop foreman, Soo Line, Minneapolis, Minn.

wear, are not necessarily the result of braking action, but have probably been brought about by lack of either uniform hardness or wearing qualities in the tread of the wheels and tires.

Low spots, in one or more places, of $\frac{1}{32}$ in. to $\frac{1}{4}$ in. in depth with comparatively little tread wear, are not unusual. These, while more pronounced in heavy tender service of 70,000 lb. and especially 100,000 lb. capacity tenders, also appear on the lighter 60,000 lb. and 80,000-lb. car and coach wheels; seemingly, indicating that this trouble is caused by lack of uniform tread structure in the wheels and tires.

Unequal hardness or wearing qualities in mated wheels, we believe, contributes also to considerable cutting of flanges. Better or more careful handling and heat treatment of all types of wheels should improve conditions and surely result in savings to the railways.

The removal from service of wheels developing low spots or uneven tread wear, as soon as noticed, not only saves road bed, track, cars, and lading, but also saves the wheel tread and service metal on steel wheels and tires. The resulting pounding rapidly destroys the tread structure, and may cause wheels to break, or make it necessary to scrap expensive steel wheels, if not removed in time.

In connection with steel wheels developing low spots from manufacturing defects, there are also the wheels developing defective tread spots from slid spots which are permitted to run. While we know of no accurate data as to how many miles a wheel with defective tread structure will run before the defects become apparent, such information as we do have on tender wheels indicates that these wheels usually have to be removed in from 1,000 to 2,000 miles after spots start to develop. The present A. A. R. charge per $\frac{1}{16}$ in. of service metal is from $1.11 to $1.27 for 33-in. wheels, and $1.82 per $\frac{1}{16}$ in. for 36-in. passenger-car wheels.

Compensation for Defective Steel Wheels

Compensation for defective steel wheels may not be claimed from the manufacturer unless the defect exceeds $\frac{3}{8}$ in. in depth, which is more than most defects by $\frac{1}{8}$ in. As it does not pay to remate wheels unless service-metal loss exceeds $\frac{1}{4}$ in. the average defective wheel, along with its mate, is turned up without remating, with a probable average loss of $\frac{1}{4}$ in. on each wheel, at a cost per pair of from $8 to $15 in service metal alone.

As the wheels must be removed from service anyway in such a comparatively short period of time or service, it would appear to be the cheapest and most economical thing to remove wheels as soon as defective spots appear, and not wait until, in addition to the removal cost, the railroad must also pay for the unnecessary service-metal loss and possible wheel scrapping, as well as the incidental losses defective wheels have on tracks, equipment, and lading.

Along this line, some criticism of the out-of-round rule on new cast-iron wheels may be justified. This rule, Page 81, Par. B, in the Wheel and Axle Manual reads, "Each wheel shall be so nearly circular that a true metallic ring placed on its tread and bearing somewhere on the cone, shall, at no point, be more than $\frac{1}{32}$ in. from the tread."

You will note there are no restrictions in this rule as to how many low spots up to $\frac{1}{32}$ in. are permissible, or as to the length or shape of such low spots. A check of new mounted wheels reveals a condition not the best for high-speed service, as shown in the journal lathe and by complaints received on new cast-iron wheels placed in caboose service.

Economy of Chilled Wheels Increased by Grinding

There does not seem to be much question as to the economy of using chilled cast-iron wheels, but it would probably be much greater if all new cast-iron wheels were ground before being placed in service. The results obtained from such grinding would be well worth the additional cost to the railway company for having all new wheels ground at the foundry.

Again referring to the Wheel and Axle Manual: In Par. 81, Page 104, is the following on inspection of new cast-iron wheels: "Where the tread shows a rough and wrinkled surface from fire-cracked chillers, the manufacturers should be notified to rectify condition, as this, when pronounced, is cause for rejection." Why not clear this rule by defining how far across the tread and

* * *

50-ton Hart selective convertible hopper car for ballast service built by the American Car and Foundry Company for the Chicago, Burlington & Quincy

how deep the wrinkles from fire-cracked chillers are to be accepted as O. K. by the railway company? There are too many arguments over this rule.

Also, Par. 88, Page 105, pertaining to seams in new wheels, which states the seriousness of this defect and need of rejecting new wheels which show any such indication, and then illustrates an extreme case of seamy tread developed in service, as shown in Fig. 68. Why not show an illustration of what should be rejected in a new wheel, and save a lot of arguments as well as broken wheels in service?

The same applies to Par. 94, which states "If the plate shows accumulation of dirt in the metal the wheel should be rejected." What is an excessive accumulation? There is nearly always some dirt.

Regarding Par. 95, which reads, "Wheels with the tread wrinkled or rough or with the sand rim projecting above the chilled surface of the tread, may be ground to make them acceptable, unless the defects are too pronounced or indicate weakness resulting from cold pouring." Why not clear the rule up with illustrations as to what wheels should and may be ground, and as to what is too pronounced or indicates weakness?

The same applied to shifted flange, Rule No. 96. These are occasionally received at the wheel shop after being in service with flanges shifted up to 1/4 in., indicating that more attention could be paid to this rule at both foundry and wheel shops.

Carbide-Tip Tools In a Car Shop

By C. G. Williams*

While I was testing carbide-tip tools in a railroad shop, the machinist who had the job of reconditioning car-axle journals came into the shop to grind four tools which had been dulled in trying to start a cut on a hardened journal that had run hot and been cooled by the application of water by the train crew. This machinist came to the lathe where the test was being carried on and after watching the job for a few minutes, went out with his tools, only to return in about 15 min. with the same four tools to be ground again. In one case, 1/8 in. was ground off a tool before it was sharp, and in each case it was necessary to walk about 600 ft. to the grinding wheel.

As this mechanic came past the lathe the second time, he asked, "Is that material hard enough to cut a burned axle?" He was told that it was hard enough if the machine would pull the load, and then he asked permission to take a carbide-tip tool and try it on burned axles.

By the time that the carbide-tip tool had been prepared and taken to the car machine shop, three more high-speed-steel tools had been dulled ready for grinding. The carbide-tip tool was put on the lathe and the cut started. This lathe, salvaged from the scrap pile, was probably 65 years old. The head had been knocked down, leaving but the main spindle and bearings. A 10-hp. d.c. motor, 1,140 r.p.m., had been installed on top of the head and so connected by link belt to the main spindle that a single speed of 140 r.p.m. was obtained. The apron had likewise been dismantled so that the feed was in but one direction and but one rate of feed could be used.

* Consulting engineer

The head spindle was equipped with a special chuck, while the tail-stock spindle was equipped with a ball-bearing center. The carriage was equipped with a special tool holder that gave great rigidity to the carbide-tip tool. (The writer has found by making thousands of tests, that most old machine tools may be equipped with carbide-tip tools and operated to advantage, providing that the tool rest is of such a type as to give a rigid support to the tool, that the machine has sufficient power to give the speeds required and that the machine, if a lathe, is equipped with a ball- or roller-bearing tail stock center).

The spindle speed of 140 r.p.m. gave 219.9 surface ft. per min. with a 6-in. journal. The feed was .018 in. per revolution and the depth of cut varied from 1/64 to 3/16 in. As even the fillet at the hub was generally burned, and always roughened, it was necessary to rework this also, so that from 1/32 to 3/32 in. was removed in reconditioning the journal with high-speed-steel tools.

If the journals are not burned they can be turned at the above speeds, feed and depth of cut with standard grades of high-speed steel by grinding the four tools on an average of every two hours, which gives an average of three journals per grind per tool. In this way 24 sets of wheels can be reconditioned in a day of eight hours, but if the journals have been burned or even discolored by heat in any part, the production is reduced to as low as eight sets of wheels per eight hours, with a grinding of four tools every 15 min. of use.

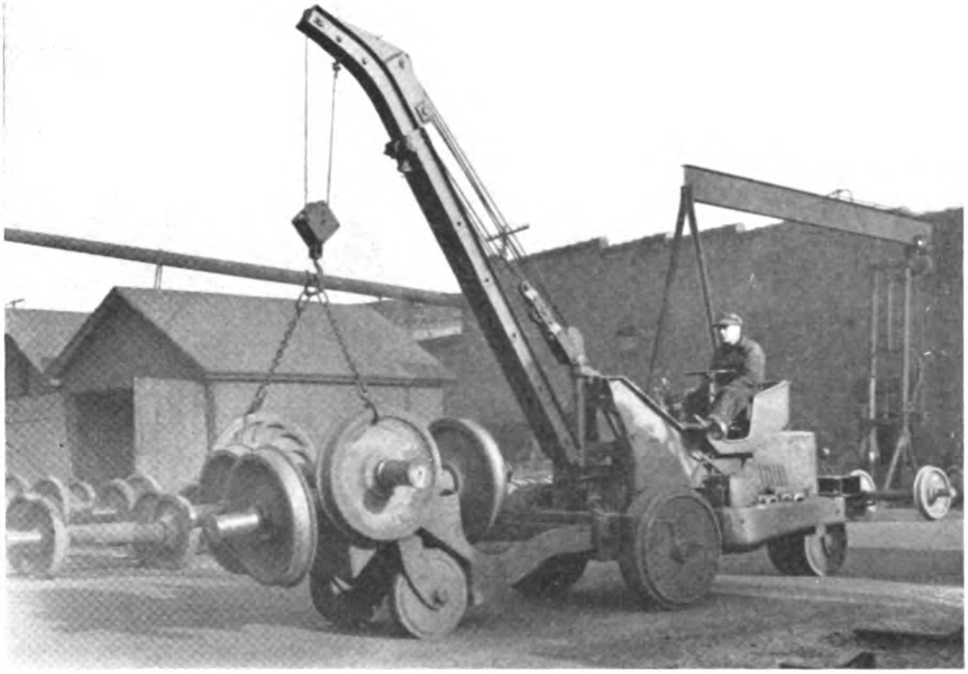
Although the carbide-tip tool was not of the correct shape to give production on the journals, the fillet could be rough turned by hand feeding of the tool to remove the hard outer shin; then the fillet could be finished with a high-speed-steel tool and the entire surface rolled to a glass-like finish with a special stellite roller.

While the machinist was skeptical as to the ability of the tool to cut the hardened steel, the writer had only in mind the rigidity of the set-up and the type of tool put on the lathe, so he was much pleased to find these items of the best obtainable. The tool was put on the lathe at 10 a.m. and one set of journals completed in the same average time as for soft journals. After one set of journals had been turned, sets of wheels were picked out that had one or both journals burned, and, in this way, five burned journals were turned on four sets of wheels with the carbide tools by the time the whistle blew for noon.

Though the tool was in good condition to continue the work indefinitely, the car foreman was so well satisfied with the test that it was called off and the original test that had been stopped was continued.

In the writer's opinion this was a very satisfactory test, the only unfavorable condition being that the one speed of the machine cut down the possible production with carbide tools on burned journals to the equal of that performed by high-speed-steel tools on soft journals. It would have been much better had it been possible to have increased the speed to 350 surface ft. per min. or more, as with the feed and depth of cut for which the tool was equipped, carbide tools would have given their greatest efficiency with a higher speed.

One thing that the machinist called our attention to was the fact that a saving in journal size, therefore journal life, was affected by the use of carbide tools as only a minimum of steel need to be removed to give the required finish while with high-speed-steel tools at least double the amount of metal must be removed to get under the skin of burned metal, and where the journal was out of round, the surface on the low side could be just scraped if carbide tools were used.



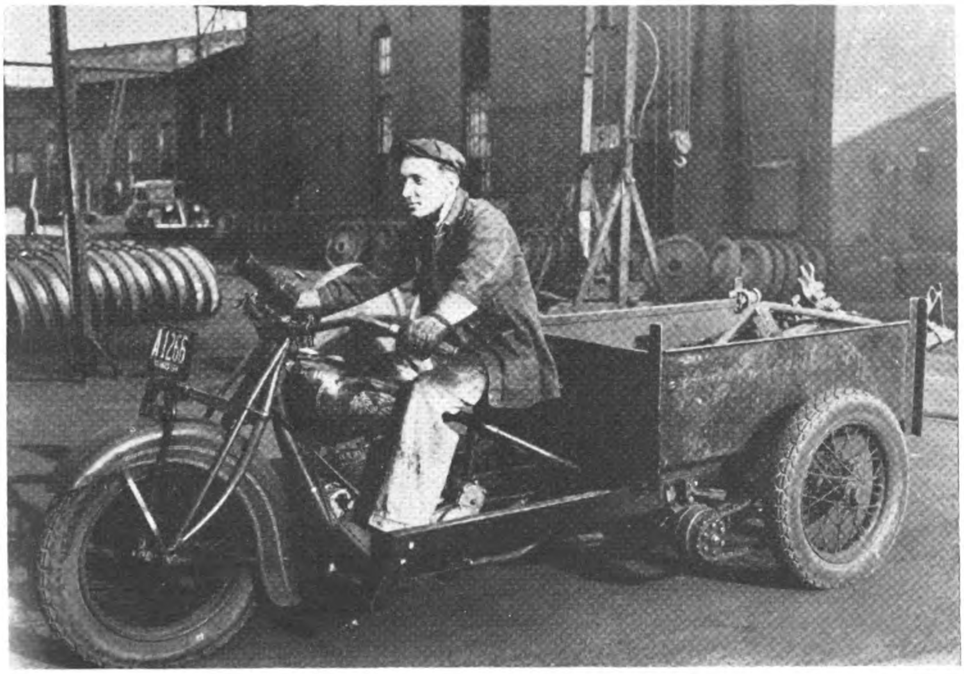
Gasoline-engine driven crane-type truck with capacity of 5,500 lb. handling three pairs of mounted wheels at the E. St. Louis shops of the Illinois Central

Expeditious Handling Of Car Materials

The illustrations included with this article show two pieces of equipment which save, in the aggregate, a large amount of time and labor in handling car materials at the East St. Louis, Ill., shops of the Illinois Central. Referring to the first view, an unusually powerful type of crane-equipped truck and trailer is shown handling three pairs of mounted car wheels which can be readily done on either smooth or rough roadway, providing the surface is fairly hard. The gasoline-engine-driven tractor, known as a Krane Kar, is very flexible and operates readily in either direction, turning in a short radius by steering-wheel control of the small rear wheels. The rugged boom has a capacity to lift 5,500 lb. at 5 ft. radius and a factor of importance is the possibility of raising or lowering this boom while it is being rotated in either direction.

The trailer is a shop-made device constructed of a heavy steel casting horizontally hinged to the front of the tractor by a substantial pivoted connection and equipped with two individually swiveling truck wheels which enable the trailer to be pushed, pulled, or swung in any direction at the will of the driver. This arrangement of boom-equipped tractor and trailer proves very convenient for the easy and rapid transportation of car wheels about the shop, loading and unloading of cars, as well as handling other heavy materials of all kinds.

The motor-cycle delivery car, shown in the second



This motor-cycle delivery car provides a rapid and flexible means of handling materials of various kinds around shops and terminals

illustration, also provides a fast and flexible means of delivering materials of all sorts about the Illinois Central shops and terminal. It consists, in this instance, of an Indian motor cycle equipped with a steel frame extension to the rear wheels which are chain driven from a differential and transmission designed to be run at somewhat reduced speed. The three-inch steel channel framework is hinge-connected to the motor-cycle frame at the front end in such a way that a slight adjustment permits taking up slack in the driving chain without much difficulty. The welded steel box mounted on the rear of the frame between the two wheels is 33 in. wide by 54 in. long by 15 in. high, dimensions which seem best adapted to average requirements.

This motor-cycle delivery car is operated about the shop on a more or less regular schedule to pick up orders and deliver material where needed without the necessity of shop men leaving their stations or being delayed waiting for material. The speed and flexibility of this unit makes it a valuable asset in any scheme of shop material delivery.

One Cause of U-12-B Valve Failure

On August 2nd, 1938, it was necessary to set out a coach on an eastern road due to the trailing pair of wheels on the rear truck having 5-in. slid-flat spots. This car was fitted with a U-12-B Universal valve, which has been inspected after the car was set out. The record showed that this valve released and applied automatically on its own accord without any supply of air being connected to the brake pipe.

From the information received it was not clear whether the brake pipe was drained at the time the car was set out or whether the angle cocks were closed and the brake-pipe pressure retained. The air-brake foreman reported that he had made a single-car test of the car and found it had 2½-lb. brake-pipe leakage and failed to pass the emergency test, but on operating a cutout cock several times, this leakage was eliminated.

With this 2½-lb. leakage it was felt that at the time of the air-brake foreman's inspection the U-12-B valve must have been in emergency, because it was 20 miles from the original point to that where the defect occurred. It was believed that the air-brake foreman could not have made his inspection in less than 25 min., and in that time the brake-pipe pressure would have dropped sufficiently to cause the protection valve to cut in and place the U-12-B valve in an emergency position.

In testing this valve on the U-12-B test rack, it passed all tests except the quick-action-chamber charging test which took 9 min. to charge to 70 lb. An examination of the valve disclosed that the ball-charging choke in the emergency-slide-valve graduating valve was stuck in its cavity.

So far as the record shows, only one pair of wheels were mentioned as being slid flat and there was no indication of the other wheels being heated due to brakes dragging. It is believed, therefore, that the cause of the slid-flat spots on the trailer pair of wheels was probably some irregularity in the brake rigging.

Regardless of what happened to the wheels, such action is attributed to insufficient charge of the quick-action chamber occasioned by a gummy deposit around the charging ball choke. With the reservoirs charged, as would be the case since these derive their charge from the service portion, air must have been trapped in the brake pipe when the car was cut out and a service application was developed due to the leakage from this line.

When the service portion moves to the service position to admit auxiliary and service-reservoir air to the brake cylinder, emergency-reservoir air from beneath the high-pressure valve will be admitted to the emergency slide valve seat port b-1*. As little pressure has been built up in the quick-action chamber, the emergency piston *will remain in its release position.* If there be an abnormal clearance between the top of the emergency-slide-valve wings and the broached guide grooves in the top of the slide bushing, the slide valve will be lifted from its seat a slight amount *to momentarily unseat the high-pressure valve.* This results in the safety-valve cutoff valve moving upward to connect passages W-1* and M* to release brake-cylinder air through the emergency-portion exhaust through passage O and cavity N*.

The emergency slide will reseat as some emergency reservoir air is passed to the quick-action chamber from the space beneath the high-pressure valve. By so doing, the high-pressure valve reseats; however, the safety-valve cutoff valve will remain in its upper position until the pressure in the space beneath the valve (brake-cylinder air) drops to a comparatively low value, at which time the release of brake cylinder air through the emergency exhaust will cease.

* See New York Air Brake Company's pamphlet No. 5050-4, Figs. 29 and 31.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Repairs And Owner's Defects on Derailed Car

The Chicago, Milwaukee, St. Paul & Pacific badly damaged an Atlanta, Birmingham and Coast hopper car in an accident. The car was later reported to owners as destroyed, with a request that they furnish a depreciated-value statement; however, after the statement was submitted the C. M. St. P. & P. elected to repair and return the car to service, and prepared a billing repair card marked "no bill" with the exception of wheels applied at R. & L-2, for which the C. M. St. P. & P. charged the owner in accordance with Rule 75. They also charged for re-light-weighing and stenciling the car after receiving extensive repairs, because the car was due for re-weighing in accordance with Rule 30, Section C.

The owner contended that due to the fact the car was badly damaged, requiring renewal of approximately 75 per cent of the car body, as well as repairs to the trucks, the charge for re-weighing the car should be absorbed by the repairing line.

In rendering a decision on November 11, 1937, the Arbitration Committee stated: "The contention of the Chicago, Milwaukee, St. Paul & Pacific is sustained."—*Case No. 1,762, Atlanta, Birmingham and Coast versus Chicago, Milwaukee, St. Paul & Pacific.*

High Spots in

Railway Affairs . . .

Wages and Hours

Whatever one may think of the wage-hour law, favorable or otherwise, there seems to be a more or less general agreement that Administrator Elmer F. Andrews is giving an excellent account of himself in its administration. A civil engineer by training, he is also a railroader, having served with the New York Central, the Bangor & Aroostook and the Seaboard. Modest in disposition and a clear and unbiased thinker, he makes a decidedly favorable impression on those with whom he comes in contact. Business Week, in commenting on the recent meeting of the National Association of Manufacturers, said that next to Anthony Eden, Andrews was the biggest drawing card, who "packed them in to the rafters." "Also interesting to most listeners,' said Business Week, "was Senator Burke's remark . . . that what the Wagner Act needed was administrators like Andrews."

"Feather-Bed Rules" Challenged

Some peculiar decisions have been made by the National Railroad Adjustment Board, heavily penalizing the railroads in connection with the so-called "feather-bed rules." Interestingly enough, no method is provided under the Railway Labor Act by which a railroad may test out an Adjustment Board decision in court. On the other hand, ample machinery has been established to enable employees to take court action against any employer who fails to abide by the decisions of the board. The Washington (D. C.) Terminal Company has broken the ice and has filed suit in the United States District Court for the District of Columbia, challenging the demand of the Brotherhood of Locomotive Firemen and Enginemen and the Brotherhood of Railroad Trainmen that the Terminal Company be required to employ special, additional switch engine crews to back trains and empty cars between the passenger station and the storage yard. The road engine which brings the train to Washington has to go to the roundhouse, and since the yard where empty trains are stored is between the station and the roundhouse, it has always been the practice, when necessary to secure prompt and efficient operation, to have the road engine take the train to the storage yard on its way to the roundhouse.

Legislative Prospects

The President's Committee-of-Six has made its report, which is excellent, except that as might be expected of a committee made up of equal numbers of representatives of management and labor, it carefully refrains from recommendations which in any way would affect labor. The report of the Transportation Conference of the Chamber of Commerce of the United States has not yet been made public, but this body, consisting as it does of representatives of various business groups, may be expected to magnify its own selfish interests and place emphasis on those things which will least affect them. Other special interests will undoubtedly press their claims before the Senate and House Committees. The Interstate Commerce Commission, naturally, made a number of recommendations in its annual report to Congress. The House Committee has announced that it will begin holding hearings on an omnibus railroad bill after the middle of January. Whether the Senate Committee, which is dominated by Senator Wheeler, will take any constructive action, remains to be seen. Just now the Senator seems to be interested in the fantastic Hastings postalized rate proposal. It is hoped, however, that Congress and the Administration will have the determination to do something really worthwhile in constructive legislation, which will insure the railroads a square deal.

Fierce Competition

In his annual review of railway operations in 1938 in the Railway Age, Dr. Julius H. Parmelee, director of the Bureau of Railway Economics, directs attention to the growing intensity of competition in the transportation field. He points out that according to the American Trucking Associations, the number of truck loadings during the first 11 months of 1938 decreased about 13 per cent, as compared with the same period in 1937, whereas railway car loadings on the same basis of comparison showed a decrease of more than 20 per cent. Tonnage through the Panama Canal showed a small decrease in the fiscal year 1938, compared with 1937, but nothing like that in railway tonnage in the same period. Passenger traffic by air continued to increase in 1938. Department of Commerce reports showing an increase in the first nine months of that year of about 14 per cent in plane-miles, and more than 17 per cent in the number of air passengers carried.

Mediation Board A Bit Disgusted

The National Mediation Board in its annual report directs attention to the fact that of the 241 cases decided during the fiscal year, 138 involved disputes among employees, as compared to 110 involving disputes between carriers and employees; two cases were interpretations of agreements previously mediated. It frankly comments upon the fact that entirely too much of the board's time is being used in settling differences between labor organizations competing for the right to represent particular crafts or classes of employees. "Unfortunately," it says, "the greatest need for the holding of such hearings has grown out of disputes over membership between two organizations, national in scope, which disputes would never have arisen had the organizations involved exerted the same efforts to agree with one another over their proposed jurisdiction that the Act expects carriers and employees to exert in the making of labor agreements." A board of this sort could hardly be expected to use stronger expressions in pointing out an abuse of this kind. Certainly, when a long suffering body is goaded to the point where it is forced to make such comments, it is high time for some of the labor leaders to mend their ways.

Monopoly Investigation

What was advocated a couple of years ago to be a trust busting expedition, but which is now commonly referred to in the news press as a monopoly investigation, has become, according to the members of the Temporary National Economic Committee, an economic study. This committee, by the way, is made up of representatives of the legislative and the executive branches of the government in equal numbers; this is said to be the first time a committee of Congress has been so constituted. It started off early in December with a dramatic presentation by several of the committee's economists of the economic problem in this country; this has followed by hearings on the use of patents in the automobile and glass container industries. The members of the committee insist that there is to be no "burning of witches." They point to a resolution which the committee recently adopted, reading that "it is the unanimous sense of this committee that its function and purpose is to collect and analyze through the medium of reports and published hearings, available facts pertaining to the items specified in Public Resolution 113 (Seventy-fifth Congress) in an objective, unbiased and dispassionate manner, and that it is the purpose of the committee to pursue its work solely from this point of view." Rumor has it that bills are already being prepared to amend the patent law. Apparently, however, the committee as such has no part in this and may be expected to oppose such bills until sufficient facts have been gathered to chart a wise course. Business has been taken for so many rides in recent years that it is not strange that the widely announced good intentions of the T. N. E. C. are being viewed with a certain degree of skepticism in some quarters. The good intentions of the more conservative members of the group, however, can hardly be questioned.

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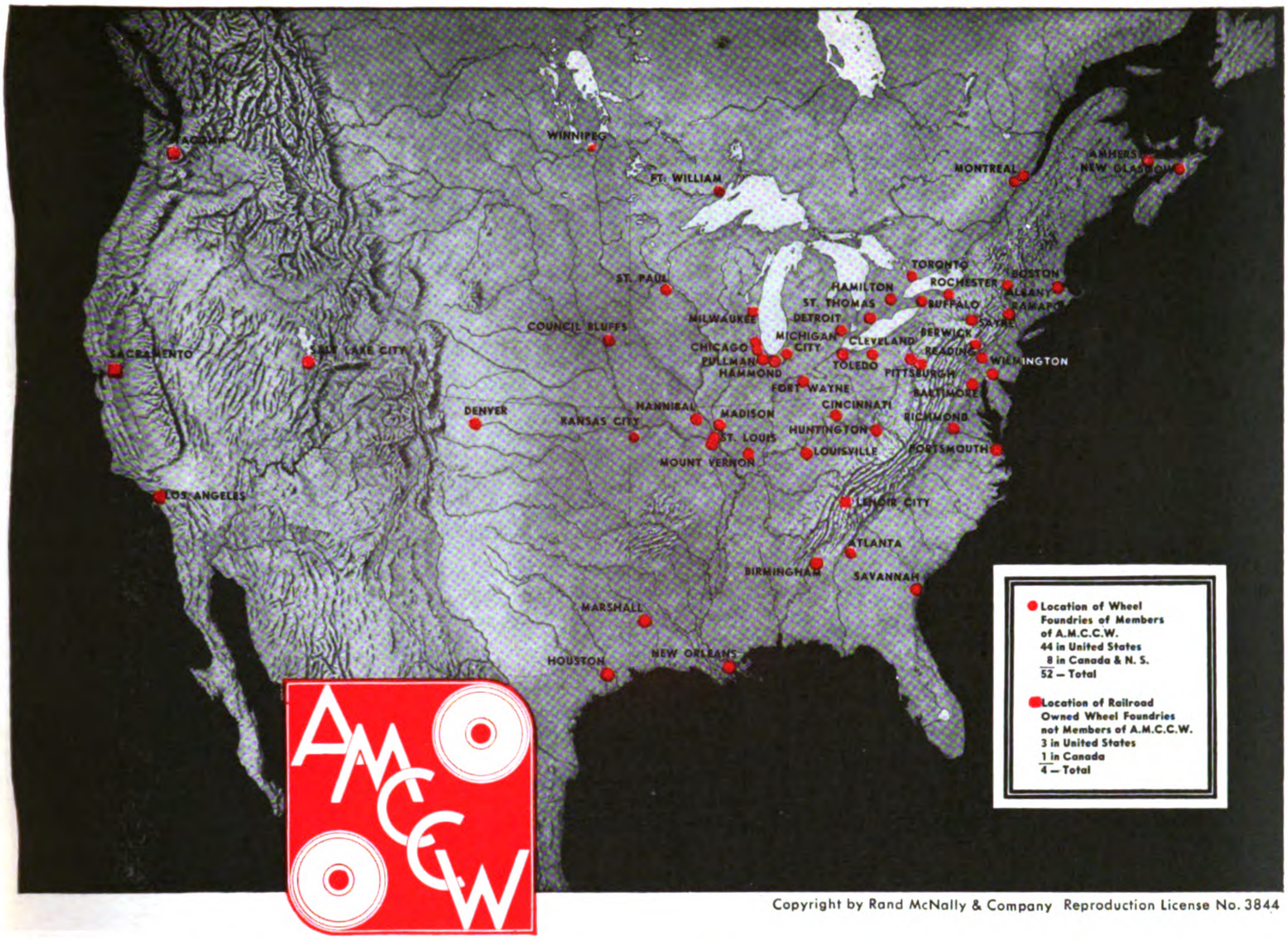

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Chilled Car Wheel plants, distributed along the lines of trunk line railways provide quick and efficient service, reduced delivery charges and a uniform market for scrap wheels, regardless of location.

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Louisville Car Wheel & Railway Supply Company
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ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

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230 PARK AVENUE
NEW YORK, N. Y.

Among the Clubs and Associations

New England Railroad Club.—"How Can We Avoid Government Ownership of Railroads" was discussed by Samuel O. Dunn, chairman of the board of the Simmons-Boardman Publishing Corporation, at the January 10 meeting.

Central Railway Club of Buffalo.—The fiftieth annual dinner of the Central Railway Club of Buffalo was held on Thursday evening, January 12, at the Hotel Statler, Buffalo, N. Y. The guest of honor was the Honorable Joseph R. Hanley, state senator, New York.

Pacific Railway Club.—F. K. Vial, vice-president of the Griffin Wheel Company, Chicago, discussed The Manufacture and Maintenance of Wheels at the meeting held on January 13. A sound motion picture, "The Story of the Chilled Car Wheel," was also presented.

Car Department Association of St. Louis.—Victor Willoughby, vice-president of the American Car and Foundry Company, New York, presented a paper, illustrated with lantern slides, on Refrigeration in Transit at the meeting of the association held on January 17, at the Hotel Mayfair, St. Louis, Mo.

Toronto Railway Club.—At the January 23 meeting, to be held at 7:45 p. m., at the Royal York Hotel, Toronto, I. I. Sylvester, special engineer of the Canadian National Railways, will discuss The Application of the Diesel Locomotive to Switching Service. Directors and officers for 1939 will also be elected at this meeting.

Southern and Southwestern Railway Club.—"Outside Looking In" was the title of the subject chosen by the speaker, Hugh K. Christie, manager, Transportation Equipment Division, Whiting Corporation, for presentation at the meeting on January 17 at the Ansley Hotel Roof Garden, Atlanta, Ga. The Yale & Towne motion picture, "Material Handling Equipment," also was shown.

Railway Club of Pittsburgh.— J. J. Cornwell, general counsel, Baltimore & Ohio, Baltimore, Md., will discuss "Troubles of the Railroads" at the meeting to be held at 8 p.m. at the Fort Pitt Hotel, Pittsburgh, Pa., on January 26.

Eastern Car Foreman's Association.—"Storage Battery Power," illustrated by sound moving pictures of The Edison Company, was the subject discussed at the January 13 meeting.

New York Railroad Club.—"The Story of the Chilled Car Wheel" will be presented by F. H. Hardin, president of the Association of Manufacturers of Chilled Car Wheels, at the meeting to be held on January 20 at 7:45 p.m. at the Engineering Societies building, New York. Contributory remarks will be made by C. B. Peck, managing editor, *Railway Mechanical Engineer.*

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

Air-Brake Association. — R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

Allied Railway Supply Association. — J. F. Gettrust, P. O. Box 5522, Chicago.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet avenue, Chicago.

American Society of Mechanical Engineers.—C. E. Davies, 29 West Thirty-ninth street, New York. Annual meeting December 5-9, Engineering societies building, New York.

Railroad Division.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

Machine Shop Practice Division.—J. R. Weaver, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Materials Handling Division. — F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

Oil and Gas Power Division. — M. J. Reed, 2 West Forty-fifth street, New York.

Fuels Division.—A. R. Mumford, N. Y. Steam Corp., 130 E. Fifteenth st., New York.

Association of American Railroads. — J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

Operating Section. — J. C. Caviston, 30 Vesey street, New York.

Mechanical Division.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

Purchases and Stores Division.—W. J. Farrell, 30 Vesey street, New York.

Motor Transport Division. — George M. Campbell, Transportation Building, Washington, D. C.

Canadian Railway Club. — C. R. Crook, 4468 Oxford avenue, Montreal, Que. Regular meetings, second Monday of each month, except in June, July and August, at Windsor Hotel, Montreal, Que.

Car Department Association of St. Louis. — J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, Hotel Mayfair, St. Louis, Mo.

Car Department Officers' Association.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

Central Railway Club of Buffalo. — Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

Eastern Car Foremen's Association. — Roy MacLeod, New York, New Haven & Hartford, New Haven, Conn. Regular meetings, second Friday of each month, except May, June, July, August and September.

Indianapolis Car Inspection Association. — R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August, and September, at Hotel Severin, Indianapolis, at 7 p. m.

International Railway Fuel Association. — See Railway Fuel and Traveling Engineers' Association.

International Railway General Foremen's Association.—F. T. James (President), general foreman, D. L. & W., Kingsland, N. J.

International Railway Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

Master Boiler Makers' Association. — A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

New England Railroad Club. — W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August, September, at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

Pacific Railway Club. — William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately, excepting June in Los Angeles and October in Sacramento.

Railway Club of Greenville—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

Railway Fire Protection Association.—P. A. Bissell, 40 Broad St., Boston, Mass.

Railway Fuel and Traveling Engineer's Association.—T. Duff Smith, 1255 Old Colony building, Chicago.

Railway Supply Manufacturers' Association.—P. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

Toronto Railway Club.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

Traveling Engineers' Association.—See Railway Fuel and Traveling Engineers' Association.

Western Railway Club.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

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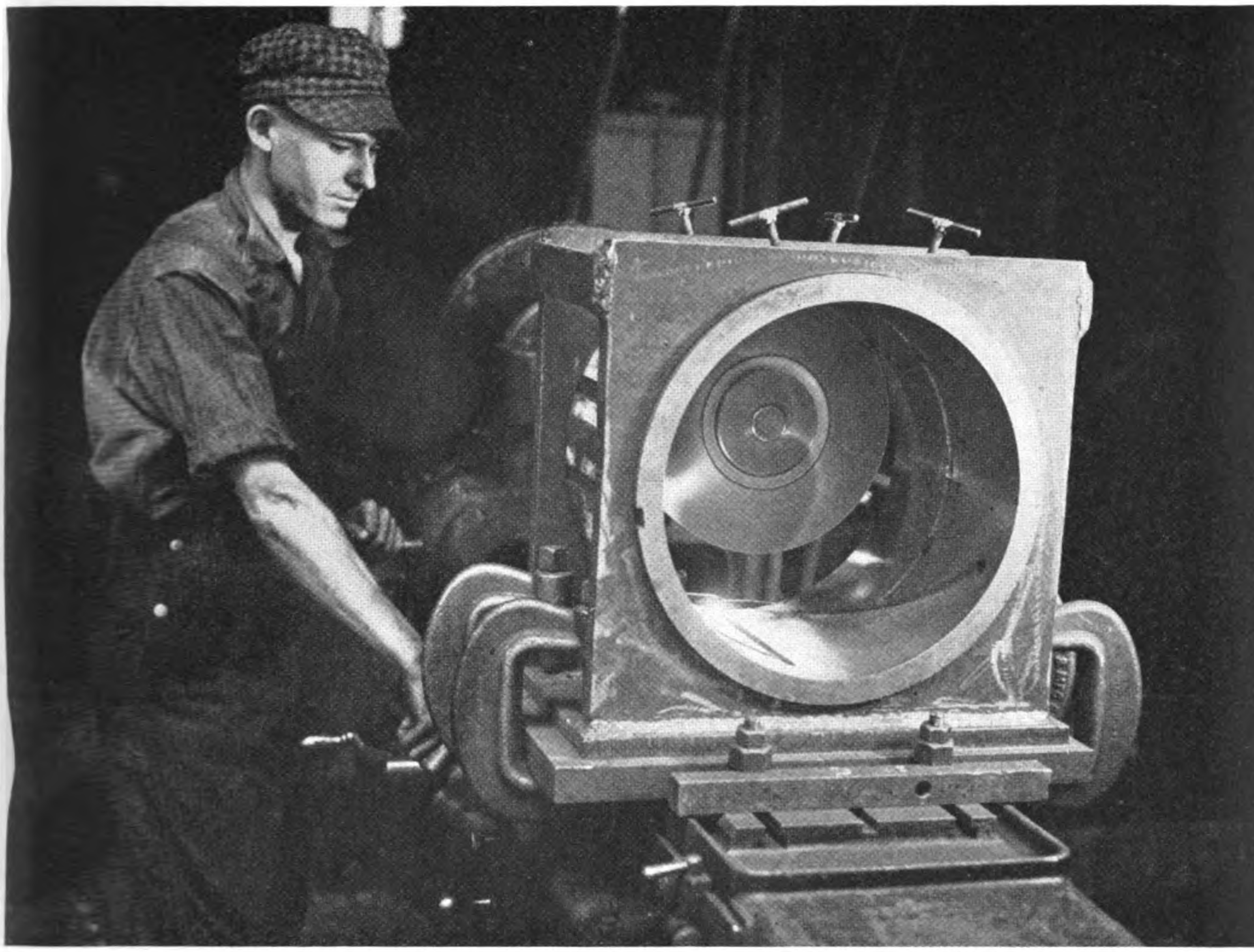
METHODS AND MACHINERY THAT GUARD LIMA QUALITY



LIMA GRINDERS . . .

accurately finish a driving box

With modern grinding equipment Lima gives a mirror finish to wearing surfaces. Here is a solid type driving box being prepared for long, trouble-free service. » » » At Lima, skill and experience is provided with modern, accurate equipment to produce the low-maintenance locomotives for which Lima is noted.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

NEWS

Automatic Stoker Case Is Again Postponed

Upon the recommendation of its chief counsel the Interstate Commerce Commission has postponed the effective date of its automatic stoker order from December 15 to February 1, 1939. The action was taken because of a suit now pending in the United States District Court for the Northern District of Ohio in which the carriers are attempting to have the commission's order set aside.

Another Six-Months Reprieve for Arch-Bar Trucks

Freight cars equipped with arch-bar trucks will be accepted in interchange at least until July 1, 1939, as a result of a recent decision of the Association of American Railroads board of directors to extend the deadline another six months. Similar action was taken last July when the deadline was moved up to January 1, 1939. At that time J. J. Pelley, president of the A. A. R., said that only about two per cent of the total railroad-owned cars, which are regarded as suitable for service or worth repairing, were equipped with arch-bar trucks.

Roads Could Spend Billion Each Year

Declaring that the railroads in the next five years could profitably expend one billion dollars annually for new freight cars, and locomotives, repair of existing equipment and improvement in track and facilities, R. V. Fletcher, vice-president and general counsel of the Association of American Railroads, on December 12, discussed before the Senate Finance Committee the advisability of amending the tax laws so as to permit such expenditures being taken into consideration in computing taxes to be paid by the railroads.

Taxes, Judge Fletcher said, place a heavy burden on the railroads especially those imposed by the states. In some of the states, he said, the same consideration is not given to the railroads as that given to other property owners. "If the federal government in determining the taxes on railroad property would take into consideration amounts which the carriers spend on rehabilitation of property," he suggested, "then that policy might have some effect on the states."

For the rehabilitation of equipment and track alone Judge Fletcher said, that according to conservative estimates, at least $600,000,000 could be spent annually in the next five years and that the amount might total $775,000,000.

Judge Fletcher told the committee that to reduce to six per cent the number of freight cars which are in need of repair, the cost would be $53,614,000. He estimated that the railroads should install 100,000 new freight cars annually in the next five years. For the seven year period—1923 to 1929—the railroads built or purchased 114,832 new freight cars annually. From 1930 to 1935 they bought only 21,000 annually. He estimated that the acquisition of 100,000 new freight cars each year for the next five years would cost $300,000,000.

Judge Fletcher also said that to reduce to ten per cent the number of locomotives in need of repair would cost approximately $25,000,000 or $7,000 per locomotive. He also said the railroads should install 2,000 new locomotives annually in the coming five year period the cost of which would be $200,000,000. In the seven years from 1923 to 1929 inclusive, the number of new locomotives acquired by the railroads was 2,075 annually. From 1930 to 1935, inclusive, he said, the railroads only purchased 174 locomotives annually, although, due to a stimulation in business early in 1937, they added 373 locomotives in that year.

Railroads Save Fuel

A new high record in fuel efficiency was made by the railroads of the United States in the first nine months of 1938, according to reports received by the Association of American Railroads. This was true both for freight and passenger service.

For each pound of coal consumed in freight service the railroads in the first nine months of 1938 hauled 8.8 tons of freight and equipment a distance of one mile, the best record in fuel efficiency that has ever been established in the freight service. This was an increase of 5.2 per cent in fuel efficiency compared with 1920, when the average for the entire year was 5.8 gross tons hauled one mile for each pound of coal used. In the first nine months of 1937 the average was 8.7 tons, and in the same period in 1936 it was 8.4 tons.

The railroads in the first nine months of 1938 used in passenger service 14.7 lb. of coal in order to haul a passenger-train car one mile which also was a new record. In the same period last year 14.9 lb. were used and in the same period in 1936 the average was 15.3 lb. Fuel efficiency in the passenger service, using the same basis of compilation, was 22 per cent greater in the first nine months of 1938 than in the same period of 1920 when the average was 18.8 per thousand gross ton-miles.

Contemplated Improvements and Equipment Purchases

St. Louis-San Francisco.—Trustees of the St. Louis-San Francisco have asked the federal district court for authority to spend $3,490,534 for roadway and mechanical improvements in 1939. Expenditures for mechanical improvements total $1,128,179 and include the purchase of five mountain-type locomotives for freight service.

Pittsburgh & West Virginia.—This company has applied to the Interstate Commerce Commission for authority to sell to the Reconstruction Finance Corporation or have the R. F. C. guarantee the payment of $1,500,000 of equipment trust certificates, the proceeds to be used to purchase 100 steel box cars and 600 50-ton, steel hopper cars. The total cost of the purchase would be about $1,675,000, and the issue of equipment trust certificates will cover 90 per cent of the cost.

Illinois Central.—This company has approved a budget of $780,000 for the conversion of thirteen 2-10-2 type locomotives into 4-8-4 type locomotives at the rate of one a month during 1939. The work will be done at the company's shops, at Paducah, Ky.

Southern. — The Interstate Commerce

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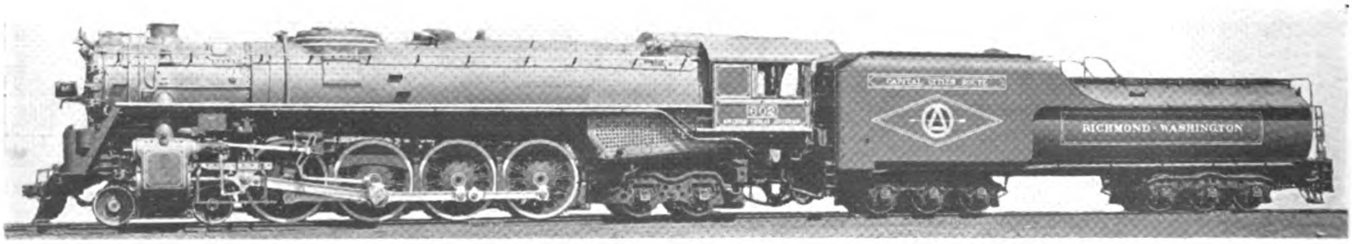
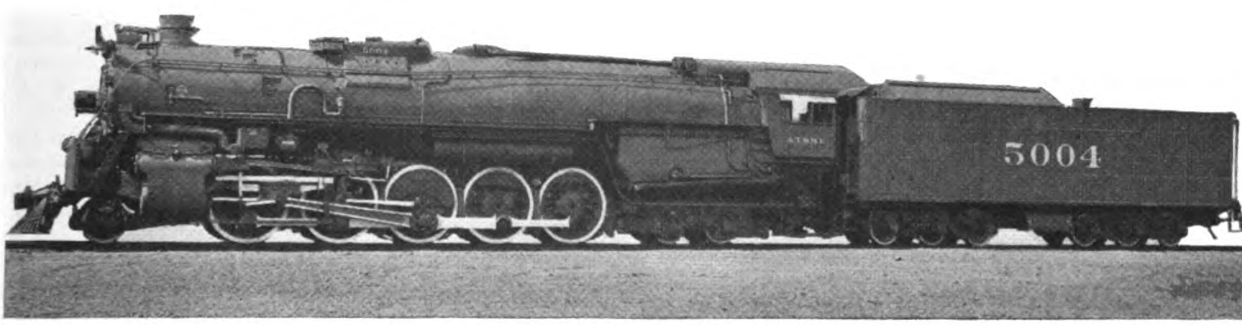


One of six "Governor" class passenger locomotives built for the Richmond, Fredericksburg & Potomac by the Baldwin Locomotive Works—The total engine weight is 406,810 lb. and the tractive force 62,800 lb.

Another Road Applies the

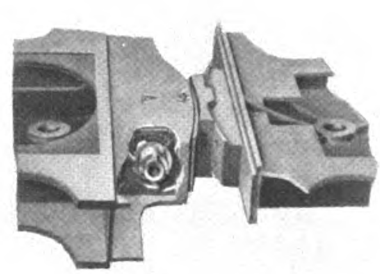
NEW RADIAL BUFFER



...to assure easier riding and greater safety

Slack has been eliminated and excessive vibration avoided by the application of Franklin E-2 Radial Buffers on new locomotives recently delivered to the Santa Fe by The Baldwin Locomotive Works. This application results in engine and tender becoming a single unit with vastly improved riding qualities, reduced maintenance, and greater safety.

On the 2-10-4 freight locomotives, reduced maintenance on both engine and track is further assured by installation of the Franklin Lateral Motion Device. Increased firing efficiency, a minimum of labor and fuel consumption, has been assured by the incorporation of Franklin Fire Doors and Franklin Steam Grate Shakers.



Franklin E-2 Radial Buffer

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Commission, Division 4, has authorized the Southern to assume liability for $6,000,000 of its four per cent equipment trust certificates. At the same time authorizing the Reconstruction Finance Corporation to purchase these certificates for itself at a price not in excess of their principal amount. The proceeds of the certificates will be used to purchase approximately 2,400 all-steel freight cars and 25 70-ft. all-steel express cars, costing an estimated $6,000,-000.

Atchison, Topeka & Santa Fe.—The Santa Fe has authorized the purchase of 30 Diesel electric switching locomotives, some of 600 hp. and some of 900 hp., at an estimated cost of more than $2,250,000. The purchase of additional equipment will be considered later.

Chicago & North Western.—The C. & N. W. has asked the Federal district court at Chicago for authority to purchase new streamline equipment and Diesel power units for two "400" trains at a cost of $2,320,000, $720,000 for the locomotive and $1,600,000 for 10 cars. Each train will consist of a locomotive and 10 cars, including a tap room-lounge car, 4 coaches, 1 diner, 3 parlor cars, and 1 observation-club car. The Diesel power equipment for each train is to consist of a double unit, with double-end control, and be capable of generating 4,000 hp. and of attaining a maximum speed of 120 m.p.h.

1939 Brings New Hope, Says Pelley

"APPROACH of the year 1939 brings to the railroads of the United States renewed hope for a solution of the critical financial situation which has faced them in the past 12 months," said J. J. Pelley, president of the Association of American Railroads, in a December 30 statement summarizing the performance of the railroads in 1938.

"At no time," Mr. Pelley went on, "has there been a greater public appreciation of their problems than now or a more earnest desire to formulate some plan that will solve the desperate situation in which the rail carriers find themselves. With the coming of the new year, railroad managements hope that early action will be taken by Congress and the state legislatures looking toward development of a national transportation policy which will place all agencies of transportation upon an equality in matters of regulation, taxation and subsidies; recognize railroads as a business entitled to the same chance to earn a living as any other business and enable the railroads to re-establish their credit.

"The railroads in the past twelve months have continued to furnish to the public the highest standard of transportation, so far as dependability and efficiency are concerned, ever attained by them. Not only were new high records made in 1938 by the railroads of the United States in the average speed of both freight and passenger trains and in fuel conservation, but there also were numerous other increases in operating efficiency as compared with 1937.

"From a financial viewpoint, however, 1938 was one of the most disappointing years that has ever been experienced. . . . We estimate that after fixed charges have been met, Class I railroads in 1938 will have a net deficit of $125,000,000, compared with a net income of $98,000,000 in 1937. The net deficit in 1938 was the greatest for any year on record except in 1932 when it was $139,000,000. While complete reports for the year are not yet available, preliminary reports indicate that the railroads will have a net railway operating income, before fixed charges, of $362,000,000, or a return of 1.39 per cent on their property investment. In 1937 it was $590,000,000, or a return of 2.26 per cent.

"Loading of revenue freight in 1938 totaled 30,362,000 cars. In only two years —1933 and 1932—since the compilation of these reports began in 1918, has this volume of traffic been smaller. . . . Passenger traffic, too, in 1938 was less than in any year since 1935, amounting to 21,800,000,000 passenger miles. This was a reduction of 11.6 per cent compared with 1937 and a reduction of 18.7 per cent compared with 1930.

"Partly because of the serious financial condition of the railroads and partly because of the fact that the volume of traffic could be handled without difficulty with existing equipment, the railroads in 1938 installed only 16,266 new freight cars. In 1937, there were 75,058 new freight cars put into service and in 1936 the number was 43,941. Class I railroads in 1938 also put in service 162 new steam locomotives and 103 electric and Diesel-electric locomotives compared with 373 steam and 77 electric and Diesel-electric locomotives in 1937 and 87 steam and 34 electric and Diesel-electric locomotives in 1936.

"New freight cars on order on December 1, 1938, totaled 4,335, the smallest number on order on that date in any year since December 1, 1934. Class I railroads on December 1 had only 17 steam locomotives and 39 electric and Diesel-electric locomotives on order compared with 131 steam and 30 electric and Diesel-electric locomotives on order on the same day one year ago. This Association estimates that if their financial condition would permit, the railroads of the United States could profitably install 100,000 new freight cars and 2,000 new locomotives annually in the next five years in order to replace older equipment with the view of bringing about a further increase in operating efficiency."

(*Turn to next left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the December Issue

LOCOMOTIVE ORDERS

Company	No. of Locos.	Type of Loco.	Builder
Norfolk & Western	10	Y-6 Mallet	Company Shops
Reading-Central of New Jersey[1]	9	600-hp. Diesel-electric	Electro-Motive Corporation
	4	600-hp. Diesel-electric	American Locomotive Co.
	1	600-hp. Diesel-electric	Baldwin Locomotive Works
	1	600-hp. Diesel-electric	Fairbanks, Morse & Co.
Union Pacific	1[2]	4,000-hp. Diesel-electric	Electro-Motive Corporation

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Norfolk & Western	500	40-ft. steel box	Pressed Steel Car Co.
	100	50-ft. steel box	Greenville Steel Car Co.
	35	Covered hopper	Company Shops
	750	55-ton steel hopper coal	Bethlehem Steel Company
	750	55-ton steel hopper coal	Virginia Bridge Company
Wheeling & Lake Erie	400	60-ton hopper	Ralston Steel Car Company
U. S. Navy	39	50-ton flat	Major Car Company

FREIGHT-CAR INQUIRIES

Canadian National[3]	2,000	Box	....
Illinois Central	1,000	50-ton gondola	....
Lehigh & New England	100	50-ton hopper	....

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
New York Central		See footnote 4	
Pennsylvania			

PASSENGER-CAR INQUIRIES

Atlantic & Western	1	Rail car with gas-mech. drive	....
Canadian National	10	Baggage	....
	5	Mail-express	....

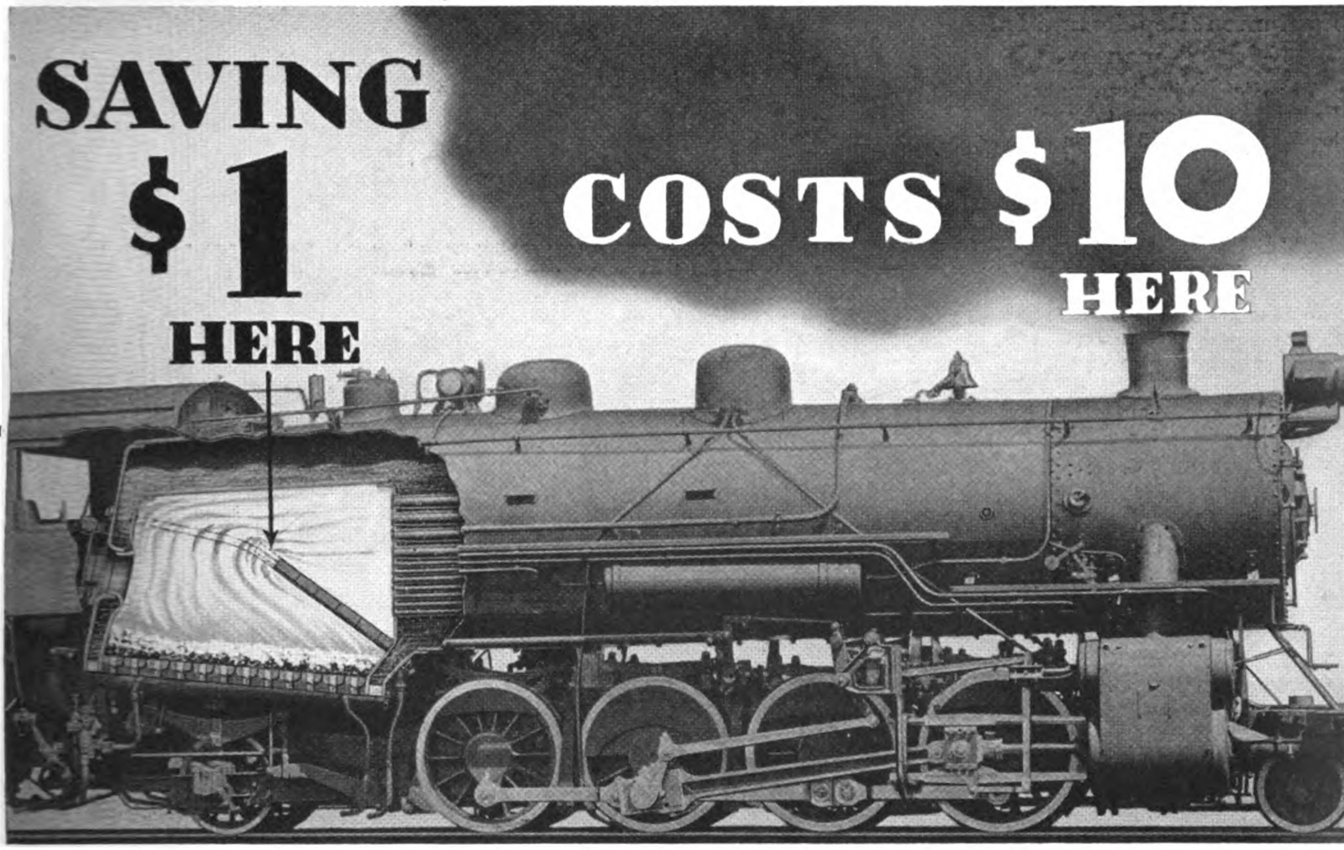
[1] Ten of the switchers will be used on the Central of New Jersey and five on the Reading. Authorization of this purchase was reported in the December *Railway Mechanical Engineer*.

[2] For use in its thirteen-car streamliner the "City of Los Angeles." Except for improvements in details and the fact that each of the four engines in the locomotive will have 1,000 hp. instead of 900 hp., the new locomotive will have the same appearance and construction principles as are embodied in the 5,400-hp. locomotives now handling the new "City of Los Angeles" and "City of San Francisco" streamline trains. The 5,400-hp. locomotives have two 900-hp. engines in each of three units.

[3] The Canadian National is also planning to construct in its own shops, during 1939, some caboose and refrigerator cars.

[4] Eighty light-weight streamline room cars are being constructed by the Pullman-Standard Car Manufacturing Company, Chicago, for the Pullman Company for operation on the New York Central and the Pennsylvania. On the New York Central the 40 cars will be used on the Detroiter, the Commodore Vanderbilt, the Water Level and the Southwestern. The cars, which will be delivered by July 1, are as follows:

	N. Y. C.	Pa.
10 roomette, 5 double bedroom	8	6
18 roomette	8	18
6 double bedroom, buffet, lounge	6	.
1 drawing room, 1 compartment, 2 double bedroom, observation, buffet	3	..
13 double bedroom	6	4
2 drawing room, 4 compartment, 4 double bedroom	9	6
12 duplex	..	6
	40	40



cut down on the arch and you boost the fuel bill

No one questions locomotive Arch economy. The Arch has been so thoroughly proved as a fuel saver by railroad after railroad for years past.

In the urge for money saving don't let the desire to save a few dollars in Arch brick expense by skimping on the Arch blind you to the fact that every dollar thus "saved", boosts the fuel bill ten dollars.

The surest way to the lowest operating cost is not in crippling proved economy devices but in making full use of them. This means complete Arches, with every brick in place, for each locomotive that leaves the roundhouse.

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.

Locomotive Combustion Specialists

Equipment Repairs and Improvements

The Wabash has been authorized by the Federal district court to install automobile loading racks in 200 freight cars and make general repairs on 100 of the cars.

The Chesapeake & Ohio recently bought 6,400 tons of fabricated steel car parts for use in repairing freight cars at its Russell, Ky., car shops.

The Pennsylvania has ordered 1,045 tons of sheets from the Carnegie-Illinois Steel Corporation. The railroad will use the steel for general repairs and maintenance of equipment at its Altoona, Pa., shops.

The Delaware, Lackawanna & Western is placing orders for materials for use on 200 freight cars at its Keyser Valley shops, Scranton, Pa.

Collision at Tortuga, Calif.

A HEAD-ON collision between two passenger trains occurred on September 2, 1938, on the Southern Pacific at Tortuga, Calif., in both of which trains certain cars of lightweight alloy-steel construction were involved. The report of the director of the Bureau of Safety of the investigation of this accident, which has been issued under date of December 2, deals with this aspect of the accident as well as with the circumstances relating to its cause.

The accident was a head-on collision between two passenger trains, No. 44 eastbound, which was standing on a siding, and No. 5 westbound, which entered the siding at between 30 and 40 miles an hour when the switch was thrown directly in front of the approaching train. The accident resulted in the death of eight passengers and three employees and in the injury of 132 passengers, three railway mail clerks, three Pullman employees and one train-service employee.

In the investigation it was disclosed that "all of the fatalities to passengers occurred in the third car of No. 44, which car was the forward section of a two-car articulated unit of lightweight streamline design. The car was telescoped a distance of 18 ft., or slightly more than one-fourth of its total length, sustaining far more serious damage than either of the two cars ahead of it. In No. 5, the car which sustained the greatest damage was the fourth car, which was practically demolished and which was likewise a lightweight, streamline car.

"In both of the trains involved in this accident these lightweight cars were being operated in association with heavy, all-steel, standard equipment, the lightweight cars being the third, fourth and fifth cars in the 11-car eastbound train, and the fourth car in the westbound 14-car train. All other cars in each of the two trains were of heavy, all-steel, standard type, thus placing the lightweight cars between the standard cars and ahead of the heavier diners, lounge cars and sleepers.

"Obviously, in the collision, the most violent impact occurred between the two locomotives, which were practically demolished and a great amount of the destructive shock was thus dissipated. The destructive shock then progressed backward, carrying to the fifth car in No. 5 and to the third car in No. 44, there being no damage to equipment in either train back of these points. There was considerable damage to the forward standard cars in each train, further dissipating the destructive force, but the first lightweight car in each train suffered the greatest damage. It is evident that the collapse of these cars further absorbed the destructive shock to such an extent that but little damage occurred beyond them."

In concluding his report the director of the Bureau of Safety recommended that "railroad officials give serious consideration to the discontinuance of operation of so-called lightweight cars between or ahead of standard cars unless and until the strength of construction has been determined by suitable tests to be substantially the same as that of other cars with which they are associated.

An editorial in the December 31 issue of the Railway Age commenting on this report says: "The fact that the superior strength of the alloy steels and the lightness of the aluminum alloys make it possible to build cars of lighter weight with both of these groups than with carbon steel . . . does not justify bundling these . . . dissimilar materials into a single category for which are inferred inferior qualities of strength and safety as compared with the older carbon steel. To do so implies a belief that weight is synonymous with strength. Such a conclusion overlooks the fact that every pound of weight added to a structure contributes to the destructive energy stored in it when in motion. Each combination of material, type of design and method of fabrication must be studied individually, and this applies as much to structures of carbon steel as to those of any of the other materials.

"Certainly the evidence presented in the report is utterly inadequate as the basis for such a general conclusion as the public is likely to infer from the recommendation in the report. Indeed, it does not adequately answer important questions concerning the specific combination of material, design and fabrication involved in this case . . . .

"Each design, of whatever material, should stand on its own ability to meet fully the Railway Mail Service Specifications. With understanding use and skilled distribution of his material, together with the assurance of the experienced designer that his structure has integrity as a unit, advantage can be taken of the superior properties of the new materials of construction for reducing weight without sacrificing strength. A failure in a single instance, from whatever cause, is insufficient reason for discouraging continued progress in lightweight passenger-car design."

Supply Trade Notes

S. A. CRABTREE and W. J. Jack have been appointed assistant district sales managers of the Republic Steel Corporation in the Chicago territory.

◆

PAUL D. CURTIS has been elected vice-president of the Marquette Railway Supply Co., Chicago, following the death of Floyd L. Ingraham, president.

◆

HARRY M. FRANCIS, assistant general manager of sales in the Cleveland, Ohio, office of the American Steel & Wire Co., subsidiary of the United States Steel Corporation, has been appointed assistant vice-president of sales.

◆

WALTER B. STRONG, manager of the export division of the Worthington Pump & Machinery Corporation, Harrison, N. J., has been appointed assistant general sales manager. Mr. Strong will continue to have general supervision of export sales and be identified with certain phases of domestic sales.

◆

THOMAS TOBY, who was formerly associated with the National Lock Washer Company, Newark, N. J., has become affiliated with the Pittsburgh Screw & Bolt Corporation as a sales representative in the New York office.

◆

ALAN E. ASHCRAFT, vice-president of Fairbanks, Morse & Company, with headquarters at Beloit, Wis., has been appointed vice-president in charge of all the company's operations in seven plants, with headquarters at Chicago.

◆

A. J. HAZLETT, formerly president of the Eastern Rolling Mill Company, Baltimore, Md., has been appointed manager of the strip-sheet sales department of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa., to succeed William Miller, who has been appointed district manager of the Detroit office.

◆

V. H. DEARLE has been appointed assistant Detroit district manager of the Carboloy Company, Inc., 2985 E. Jefferson avenue, Detroit, Mich. Mr. Dearle has been with the Carboloy Company since its formation in 1928 and is a charter member of the American Society of Tool Engineers.

◆

G. CLIFFORD LIVEZEY has been elected president and general manager, and Charles H. Atherholt, vice-president, of the Metals Coating Company of America, Philadelphia, Pa. Mr. Livezey was formerly with W. S. Hurst & Company, certified public accountants and industrial engineers.

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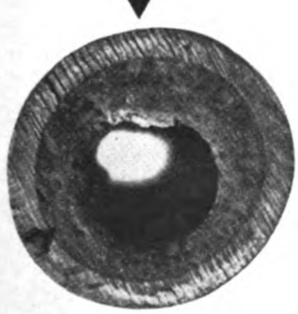
Stop carrying high water;

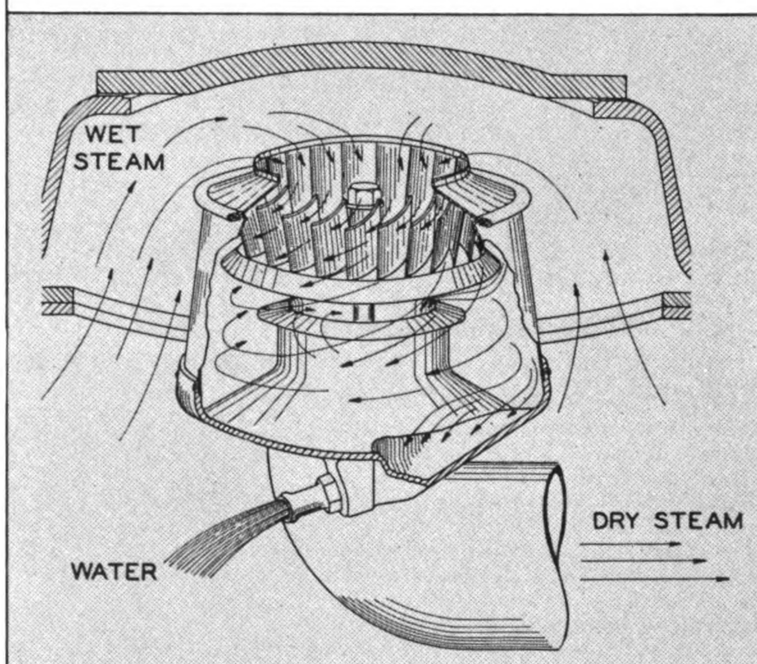
then reduce the moisture content of steam entering the superheater with the tangential dryer;

and your superheater units will not look like this



The Elesco tangential steam dryer effectively removes moisture from the steam.

It operates with an efficiency of better than 80% with 20% of moisture in the steam.



APPLICATION OF AN ELESCO TANGENTIAL STEAM DRYER.

THE SUPERHEATER COMPANY

ELESCO A-1290

Representative of AMERICAN THROTTLE COMPANY, INC.

60 East 42nd Street, NEW YORK 122 S. Michigan Ave., CHICAGO

Canada: THE SUPERHEATER COMPANY, LTD., MONTREAL

Superheaters • Exhaust Steam Injectors • Feed Water Heaters • American Throttles • Pyrometers • Steam Dryers

THE HOLLAND COMPANY, Chicago, has entered into a contract with August W. L. Hartbauer, whereby it will handle the sales of refrigerator-car hatch-closure mechanisms and Cap-Seal cushion rubber gaskets under Hartbauer patents issued and pending.

◆

CHARLES E. BRINLEY, acting vice-president with executive powers, of the Baldwin Locomotive Works, has been elected president to fill the vacancy caused by the resignation of George H. Houston last August. William H. Harman, vice-president and general manager of the Baldwin-Southwark Corp., has been elected vice-president in charge of sales, and Robert S. Binkerd has resigned as vice-president and director of sales.

Charles E. Brinley, who has been associated with the American Pulley Company of Philadelphia, Pa., since 1901 and has served as its president since 1919, was born in Philadelphia in 1880 and received his higher education as a mechanical engineer at Yale University, receiving his bachelor

C. E. Brinley

degree in 1900 and a degree from the Sheffield Scientific School in 1901. He is a member of the American Society of Mechanical Engineers, a director of a number of important industrial, public utility and insurance companies and a trustee of the Drexel Institute of Technology. While his own connection with Baldwin is of recent origin, Mr. Brinley's father, before he founded the American Pulley Company, is reported to have served as a chemist with the Midvale Company, now a Baldwin subsidiary, in its early days. Mr. Brinley was elected a director and member of the executive committee of the Baldwin Locomotive Works on the occasion of its reorganization under Section 77B of the Federal Bankruptcy Act earlier this year.

William H. Harman, who has been elected vice-president in charge of sales of the Baldwin Locomotive Works, will continue as vice-president also of Baldwin-Southwark Corporation. Mr. Harman was, for 21 years, a member of the staff of R. D. Wood & Co., and, for some time prior to his leaving that company in 1915, held the position of sales manager of the hydraulic machinery division. From 1915 to 1929 he was president of the Southwark Foundry & Machine Co., and when this company became, in 1929, part of the Baldwin group under the corporate name of Baldwin-Southwark Corporation, he became vice-president and general manager. Mr. Harman is a member of the American Society of Mechanical Engineers, is president of the Diesel-Engine Manufacturers' Association, and a member of the executive committee of the Hydraulic Machinery Manufacturers' Association.

◆

ROBERT S. BINKERD has resigned as vice-president and director of sales of The Baldwin Locomotive Works, and is planning to take a short rest before taking up other

R. S. Binkerd

work. Graduating from Yale in 1904, after considerable experience with different types of civic associations, Mr. Binkerd in 1917 became assistant to the chairman of the old Railway Executives' Advisory Committee, which later became the Association of Railway Executives. In 1923 he became associated with the Eastern President's Conference, being appointed vice-chairman of the committee on public relations. From 1927 to 1929 he was a partner with the stock exchange house of Jas. H. Oliphant & Co., of New York and Chicago. For the next several years he was retained in connection with various matters by different companies, including a number of banks and trust companies. During this period he also was one of the arbitrators who determined the value of the minority stock of the Michigan Central Railroad in connection with the New York Central unification plan. In the spring of 1931 he made a study of the economics of the use of motive power and in July of that year became associated with the Baldwin Locomotive Works.

◆

KENNETH J. TOBIN, assistant vice-president for the Camel Sales Company, Chicago, has been appointed vice-president, and A. G. Dohm, assistant vice-president has also been appointed vice-president. L. F. Duffy has been appointed assistant vice-president.

◆

THE OHIO BRASS COMPANY, Mansfield, Ohio, has announced that Claude R. Kingsbury, Seattle, Wash., has taken over the territory formerly handled by J. W. Watkins, who is leaving the employ of the company. Mr. Kingsbury has been with the company since 1927.

◆

HOWARD V. CLARK, general manager of the order division for the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa., has been appointed manager of sales of the sheet division of the corporation's general sales department. Mr. Clark succeeds Avery C. Adams, resigned.

◆

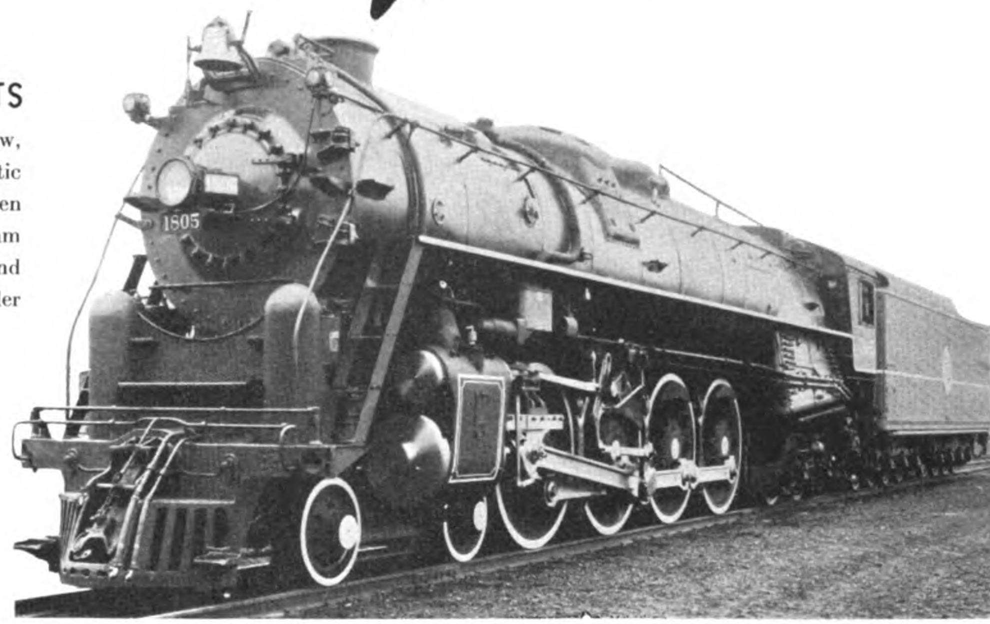
HARRY F. KNAPP who has been associated since 1903 with the Carnegie-Illinois Steel Corporation, a subsidiary of the United States Steel Corporation, serving since 1931 as manager of sales of the Washington district sales office, has been appointed manager of sales, special accounts, with headquarters at Washington, D. C., and Andrew J. Snow, who joined

* * *

The New Irvin Works of the Carnegie-Illinois Steel Corporation Dedicated on December 15

The chief units of the plant are an 80-in. hot strip mill, an 84-in. tandem cold reducing sheet mill, and a 42-in. tandem cold reducing tin mill, supplemented by the necessary annealing furnaces, picking and tinning departments. The mills are electrically operated and have an annual capacity of 600,000 tons

The Choice is BARCO for Modern Power



These locomotives are designed for continuous runs in passenger service between Richmond and Jacksonville.

BARCO PRODUCTS

are serving the twelve new, up-to-date 4-8-4 Type Atlantic Coast Line locomotives between engine and tender for steam heat, air brake, signal and stoker lines, and rear of tender steam heat connections.

Increased boiler pressures, greater speeds and improved railroad services . . . among other factors . . . have materially raised the standards of performance required from *locomotive specialties.* The maximum safety, economy and reliability of modern train operations are, to a considerable extent, dependent upon the degree to which numerous "special" devices have been designed or improved for these modern needs.

BARCO Products are *engineered* to meet the issue; a fact thoroughly demonstrated on most of the finest locomotives and trains in North America.

BARCO Experience and Leadership Help Assure the *Results* Demanded Today.

BARCO MANUFACTURING CO.

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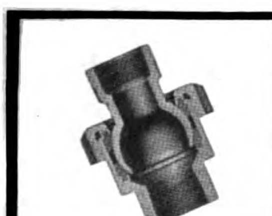
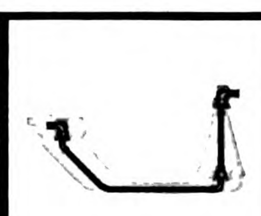
In Canada THE HOLDEN CO., LTD. Montreal—Moncton—Toronto—Winnipeg—Vancouver



BARCO Flexible Joints



Type 3-V Engine Tender Connection

BARCO Low Water Alarm

Power Reverse Gear

Metallic Car Steam Heat Connection

the company in 1912 and has spent his entire business career in that service, has been promoted from assistant manager of the Washington district sales office to manager of sales of that office.

◆

W. W. Sebald, vice-president and assistant general manager of The American Rolling Mill Company, Middletown, Ohio, has been elected a director of the company, to fill the vacancy on the Armco board of directors caused by the death of J. H. Frantz, of Columbus.

◆

The Association of Manufacturers of Chilled Car Wheels has established a research project at Battelle Memorial Institute on chilled irons for use in car wheels, according to an announcement by F. H. Hardin, president of the association, and Clyde E. Williams, director of the Battelle Memorial Institute. The work will comprise a critical study of the material in current use and of new compositions in the iron carbon group of metals.

◆

Thomas R. Cook, manager of inspection and field service of the Baldwin Locomotive Works, Philadelphia, Pa., has resigned to enter the service of Coverdale & Colpitts, consulting engineers, 120 Wall street, New York. It was during former association with Coverdale & Colpitts that Mr. Cook made the initial study of the relation of age to the cost of locomotive maintenance. Much of his attention while with Baldwin was directed to the study of motive-power economics.

◆

Avery C. Adams, manager of sales, sheet division, of the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa., has resigned to become vice-president and assistant general manager of sales of the Inland Steel Company, Chicago. Mr. Adams was employed by the Trumbull Steel Company, Warren, Ohio, in various capacities from 1919 to 1928. He resigned from this company as assistant general manager of sales in May of that year to become manager of the tin plate division of the Republic Steel Corporation. In July of the same year, Mr. Adams entered the employ of the General Fireproofing Company in Youngstown, Ohio, as vice-president in charge of sales. He resigned from the latter position in June, 1936, to become manager of sales of the sheet division of the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.

◆

V. B. Emrick, representative of the Westinghouse Air Brake Company, at Washington, D. C., has been appointed southeastern district manager, with headquarters at Washington. He succeeds Robert Burgess, who has retired after 45 years of continuous service with the company. Mr. Emrick, after serving for nine years with the Atchison, Topeka & Santa Fe as fireman and locomotive engineman, was employed by the Locomotive Stoker Company successively as mechanical expert and representative. He entered the employ of the Westinghouse Air Brake Company in 1929 as mechanical expert, at St. Paul, Minn. One year later he was transferred to the St. Louis, Mo., office and in May, 1938 became representative at Washington.

◆

The American Locomotive Company, on December 13, received from the people of Schenectady, N. Y., under the sponsorship of the Chamber of Commerce of that city, a plaque commemorating the establishment of the locomotive-building plant there in 1848. A unique feature of the exercises at Schenectady was the presentation of two prizes for the best locomotive models made by residents of that city at a dinner in the evening at the Van Curler Hotel. President William C. Dickerman of the American Locomotive Company, in responding to greetings and well wishes, spoke on "Ninety Years of Locomotive Building."

The Schenectady plant became a part of the American Locomotive Company in 1901 when the Schenectady Locomotive Works and seven other locomotive building concerns were merged under that name. Two more companies were added later.

Obituary

Floyd L. Ingraham, president of the Marquette Railway Supply Company, Chicago, died in that city on November 28, of heart failure.

◆

Horace B. Spackman, retired vice-president of the Lukens Steel Company, Coatesville, Pa., died on December 11 of a heart attack at the age of 77. Mr. Spackman was born in Caln township, near Coatesville, on October 21, 1862, and attended grade school there and later John-

Horace B. Spackman

son's Academy, near Guthriesville. In January, 1881, Mr. Spackman started work with the Lukens Steel Company as an office boy and in 1892 was appointed purchasing agent of the company. He became vice-president in 1900, retiring from active duty in May, 1929, after more than 48 years of continuous service with the company. From 1897 until his death he served as a director of the Lukens Steel Company.

◆

Russell B. Tewksbury, chairman of the board of The Oster Manufacturing Company, Cleveland, Ohio, died on January 1, at his winter home in Sarasota, Florida, at the age of 79 years. Mr. Tewksbury was one of the founders of this company in 1893. In 1898, Mr. Tewksbury became the president of the company, which position he retained until five years ago when he became chairman of the board. He was also a director of the Cleveland Tractor Company and the Electric Railway Improvement Company, of Cleveland.

◆

George Thomas Cooke, president of the American Railway Products Company, Darien, Conn., died on November 8. Mr. Cooke was born at Chicago, on May 28, 1883. He began his career in 1901 as ap-

George Thomas Cooke

prentice draftsman with the Pullman Company. In 1903 he served as chief draftsman at the Pullman Calumet shops, and from 1906 to 1911 was mechanical inspector. He served from 1911 to 1917 as southern manager of the Chicago Car Heating Company, Atlanta, Ga., and then went to New York as eastern manager of the Vapor Car Heating Company. From 1918 to 1925 he was vice-president of the Union Metal Products Company and during the latter year became president of the American Railway Products Company. Mr. Cooke then began the manufacture of devices of his own invention.

◆

G. LaRue Masters, vice-president in charge of sales of the National Lock Washer Company, Newark, N. J., whose death on October 25 was reported in the November issue of the *Railway Mechanical Engineer*, started his early career in the paper business. He later served as manager and then as president of Unger Brothers, silversmiths. During the World war, Mr. Masters worked with the aircraft industry and after the war, became associated with the National Lock Washer Company in the car equipment department and later became vice-president in charge of all sales of the company. Some years ago, he was elected a director of the company and was serving as a director and vice-president at the time of his death.

◆

Frank D. Miller, president and general manager of the National Brake Company, Inc., Buffalo, N. Y., died on December 6, at Buffalo General Hospital after a short illness. Mr. Miller was born at Tunk-

(*Continued on second left-hand page*)

hannock, Pa., 60 years ago. He was educated at Wyoming Seminary and Princeton University. In 1905 he went to Buffalo and became associated with the National Brake Company and from 1910 to the time of his death had been president and general manager of that company.

◆

Lewis T. Canfield, who retired as vice-president of the Cardwell Westinghouse Company, Chicago, in 1936, died in that city on December 3, after a short illness. Mr. Canfield was born on December 3, 1861, and entered railway service in 1879, in the shops of the Indianapolis, Cincinnati & Lafayette, subsequently serving with its successor, the Indianapolis, Cincinnati

Lewis T. Canfield

& St. Louis, which later became a part of the Cleveland, Cincinnati, Chicago & St. Louis. In 1889, he entered the employ of the Chicago, Rock Island & Pacific, and for nine years was foreman and division master car builder. In 1898, Mr. Canfield resigned to become associated with the Standard Railway Equipment Company, and on April 15 of the following year, was appointed master car builder of the Delaware, Lackawanna & Western. He remained in this position until December, 1902, when he entered the employ of the American Car and Foundry Company, where, until 1910 he was in charge of car building in Manchester, England, and in Italy. In 1910, he resigned to become vice-president of the Cardwell Westinghouse Company.

◆

William R. Seigle, chairman of the board since 1929 and research director of the Johns-Manville Corporation, died at St. Mary's Hospital, Rochester, Minn., on December 27.

◆

Frank N. Hoffstot, founder and former president of the Pressed Steel Car Co., Inc., Pittsburgh, Pa., died on December 25 at his home in New York City, after a brief illness, at the age of 77 years.

◆

Roswell P. Cooley, who served as eastern manager of the Vapor Car Heating Company, New York, until about 1934, and had been for many years in the railway supply business, died suddenly on December 21 in the Embassy Hotel, where he made his home in New York City.

◆

Samuel G. Rea, vice-president of the Standard Railway Equipment Company, whose death on November 16 was reported in the December issue of the *Railway Mechanical Engineer,* was born at Marietta, Ohio. Mr. Rea was educated at the Eastman Business College, Poughkeepsie, N. Y., and first started work with the Vivian Bond & Company, metal importers. He then organized the Century Railway Equipment Company and in 1911 went with the Standard Railway Equipment Company as vice-president in charge of sales in the eastern district, with headquarters at New York. He attended the Second Plattsburg Camp, Plattsburg, N. Y., during the World War and attained the rank of lieutenant-colonel in the 305th Field Artillery.

◆

C. E. Eklind, vice-president of the Camel Sales Company, a subsidiary of the Youngstown Steel Door Company, Chicago, died in that city on December 1, of a complication of ailments. Mr. Eklind

C. E. Eklind

was born on October 8, 1878, at Orebro, Sweden, and was educated in that country and in Germany where he took post graduate work. He was first employed by the Pressed Steel Car Company, and in 1904 entered the mechanical department of the Atchison, Topeka & Santa Fe, where he served as a designing engineer. In 1923 he resigned to enter the employ of the Camel Company, Chicago, and in 1935 was elected vice-president of the Camel Sales Company, which became a subsidiary of the Youngstown Steel Door Company on December 1, 1937.

Personal Mention

General

M. J. Donovan has been appointed mechanical assistant, locomotives, office of the chief mechanical officer of the Chesapeake & Ohio, with headquarters at Cleveland, Ohio.

Joseph Brodnax Blackburn, mechanical assistant (locomotives) to the chief mechanical officer of the Chesapeake & Ohio, Pere Marquette and Nickel Plate, has been appointed mechanical engineer, with headquarters at Richmond, Va.

J. A. Pilcher, mechanical engineer of the Norfolk & Western, with headquarters at Roanoke, Va., has retired. Mr. Pilcher was born in Richmond, Va., on January 24, 1868. He attended high school in Petersburg, Va., and, in 1889, at the end of his freshman year at Cornell University, entered the service of the Richmond Locomotive and Machine Works (predecessor of the American Locomotive Company). On January 13, 1891, he became a draftsman in the mechanical engineer's office of

J. A. Pilcher

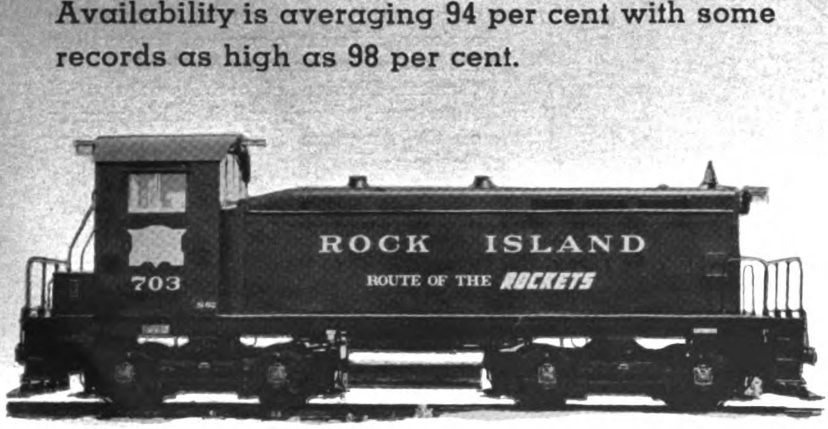
the N. & W. Eight years later he was asked to join the engineering staff of the Baldwin Locomotive Works. Three years later, in 1902, he was called back to the N. & W. as mechanical engineer. During his many years with the railroad Mr. Pilcher supervised the designing of more than a dozen different classes of locomotives. He has been active in the work of the Mechanical Division of the Association of American Railroads and is a life member of the American Society of Mechanical Engineers.

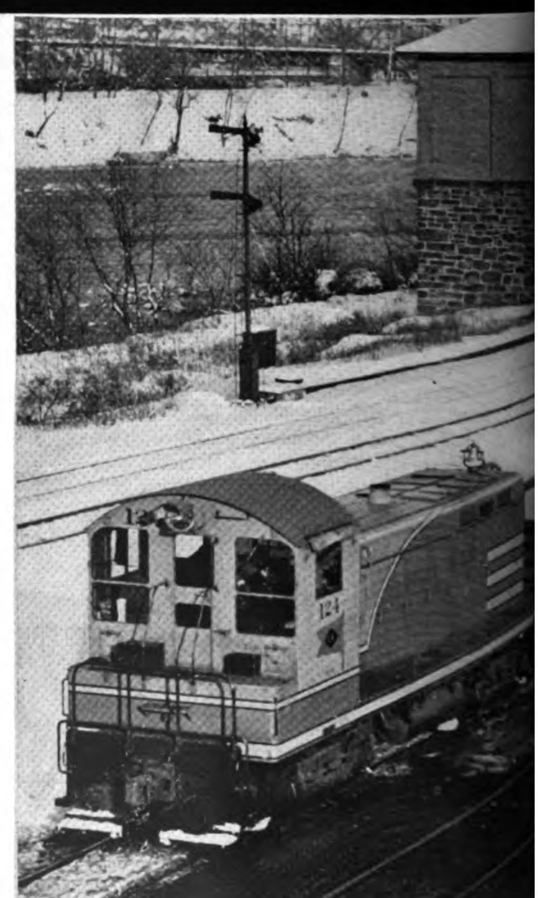
H. W. Reynolds, assistant mechanical engineer of the Norfolk & Western, has been appointed mechanical engineer, with headquarters at Roanoke, Va., succeeding J. A. Pilcher, who has retired. Completing his education in the early 1900's, Mr. Reynolds was employed, first, in the test department of the American Locomotive Company at Richmond, Va., then as a machinist in the employ of the Newport News Shipbuilding and Dry Dock Co., and later as a draftsman for the Ball & Wood Company, New York, and the Ironton Engine

Something New in

100%

THERE are many outstanding records of EMC economy and performance which are responsible for this overwhelming swing to Diesels. Based on well over one million hours of service, EMC Diesel Switchers are operating at a 75 per cent reduction in fuel expense — Maintenance costs and enginehouse expenses have been slashed 50 per cent and 66 per cent respectively — and water costs are eliminated entirely . . . Availability is averaging 94 per cent with some records as high as 98 per cent.





ELECTRO-MOTIVE

SUBSIDIARY OF GENERAL MOTO

Railroad Statistics

Of Standard Switcher Purchases Reported in 1938 Were...

DIESELS

TRANSLATED into dollars and cents—EMC Diesels are saving more than $1,000.00 per month over and above carrying and amortization charges.

This tremendous earning power makes EMC Switchers the most profitable motive power investment. And remember this—EMC Diesels will normally pay for themselves out of savings in five years.

CORPORATION

LA GRANGE, ILLINOIS, U. S. A.

Company. His affiliation with the N. & W. as a draftsman in December, 1905, followed a period of service with the then Virginia Bridge & Iron Company at Roa-

H. W. Reynolds

noke. In 1918 he was promoted to the position of mechanical inspector, and for four years he was foreman and assistant general foreman in the electric locomotive department of the N. & W. at Bluestone, W. Va. Returning to Roanoke on July 5, 1928, Mr. Reynolds served as mechanical inspector until November 16, 1936, when he was appointed assistant mechanical engineer.

Thomas Britt, general fuel agent of the Canadian Pacific, with headquarters at Montreal, Que., has retired after nearly 51 years of service.

L. E. Grant, chief chemist and metallurgist of the Chicago, Milwaukee, St. Paul & Pacific, has been appointed metallurgical and welding engineer, serving all departments.

Jose Morales Sanchez has been appointed superintendent of motive power of the Southern Pacific in Mexico, with headquarters at Empalme, Son., Mexico, succeeding A. Kasten.

Master Mechanics and Road Foremen

F. A. Lindeman, master mechanic of the New York Central at Avis, Pa., has retired.

C. A. Pease has been appointed master mechanic of the New York Central at Avis, Pa., succeeding F. A. Lindeman.

Ashburne Oliver, assistant engineer of tests of the Norfolk & Western at Roanoke, Va., has been appointed assistant road foreman of engines of the Radford division, with headquarters at Roanoke, Va.

Antone Miller, trainmaster and road foreman of engines of the Toledo division of the Pennsylvania, has been appointed trainmaster and road foreman of engines of the Grand Rapids division, to succeed J. D. Scott, deceased.

Harry N. Rowles, assistant trainmaster of the Pittsburgh division of the Pennsylvania, has been promoted to the position of trainmaster and road foreman of engines of the Toledo division.

W. H. Jackson, assistant road foreman of the Norfolk division of the Norfolk & Western at Crewe, Va., has been promoted to the position of road foreman of engines, Pocahontas division, with headquarters at Bluefield, W. Va.

J. J. Thompson, assistant road foreman of engines of the Radford division of the Norfolk & Western at Roanoke, Va., has been appointed assistant road foreman of engines of the Norfolk division, with headquarters at Crewe, Va.

B. R. Carson, assistant road foreman of engines of the Philadelphia Terminal division of the Pennsylvania, has been appointed assistant road foreman of engines of the Pittsburgh division, with headquarters at Conemaugh, Pa.

P. R. Logue, an engineman on the Williamsport division of the Pennsylvania, has been appointed assistant road foreman of engines of the Philadelphia Terminal division, with headquarters at Philadelphia, Pa.

Shop and Enginhouse

G. E. Payne, gang leader at the Shaffers Crossing shop of the Norfolk & Western at Roanoke, Va., has been promoted to the position of assistant foreman at that shop.

Gilbert B. Price, automatic train control mechanic in the shops of the Norfolk & Western at Roanoke, Va., has been promoted to the position of assistant foreman in the erecting shop at Roanoke.

E. G. Speese, assistant foreman in the erecting shop of the Norfolk & Western at Roanoke, Va., has been promoted to the position of foreman in the erecting shop at Roanoke.

P. T. Briers, general foreman of the locomotive shops of the Chesapeake & Ohio at Charlottesville, Va., has been transferred to the position of general foreman at the Hinton, W. Va., locomotive shops.

Edward L. Richardson, foreman of the erecting shop of the Norfolk & Western at Roanoke, Va., has retired. Mr. Richardson became an apprentice in the employ of the N. & W. on February 12, 1887. He progressed through the positions of gang foreman, foreman and general foreman at West Roanoke, and on February 15, 1918, was appointed master mechanic on the Norfolk division. He returned to the Roanoke shops as foreman, erecting shop on January 1, 1919.

Obituary

William C. Smith, who retired in 1937, as master mechanic of the Missouri-Pacific, with headquarters at Dupo, Ill., died on December 20, at Manchester, Mo.

E. Z. Mann, general mechanical instructor of the Atlantic Coast Line, with headquarters at Waycross, Ga., died at his home in that city on November 3. After acting in various other capacities, Mr. Mann served as road foreman of engines of the Atlantic Coast Line from 1918 to 1927, when he became general mechanical instructor.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

"Kennametal."—McKenna Metals Company, 182 Lloyd avenue, Latrobe, Pa. 24-page catalog, No. 2. "Kennametal" tools and blanks for steel and metal cutting.

◆

Nickel Alloy Steels.—The International Nickel Company, Inc., New York. Data Sheet No. 1, Section III—a 42-page booklet on the Properties and Uses of Some Cast Nickel Alloy Steels.

◆

Insulating and Cushioning Materials.—American Hair & Felt Company, Chicago. Catalog No. 38. A complete catalog of hair-felt products for thermal insulation, sound absorption and general cushioning.

◆

Contour Sawing.—Continental Machine Specialties, Inc., 1301 Washington avenue South, Minneapolis, Minn. 150-page, thumb-indexed Handbook on Contour Sawing, plus "100 examples of ways to cut machining costs" as submitted by Doall users.

◆

High Production Cutting Tools. — Scully-Jones & Company, Chicago, Engineering Manual No. 400. An unusually comprehensive catalog of standard and special high-production cutting tools. Essentially a book bound in imitation leather and containing 319 8-in. by 11-in. pages. The picture index in the first 17 pages shows each tool and gives its correct name, the reference page on which is additional descriptive data, stock sizes, etc.

◆

Cold-Drawn Steels. — Union Drawn Steel Division of the Republic Steel Corporation, Cleveland, Ohio. 24-page illustrated handbook, "Cutting Costs with Cold-Drawn Steels." A non-technical discussion of the results of cold drawing and the best methods of utilizing the improved physical properties of the steels. Said to be the first published work outlining the full story of the advantages of cold-drawn steels and showing how these steels can be used in reducing the cost of manufacturing machined and structural parts. Designed also to serve as a guide in the selection of materials for such applications.

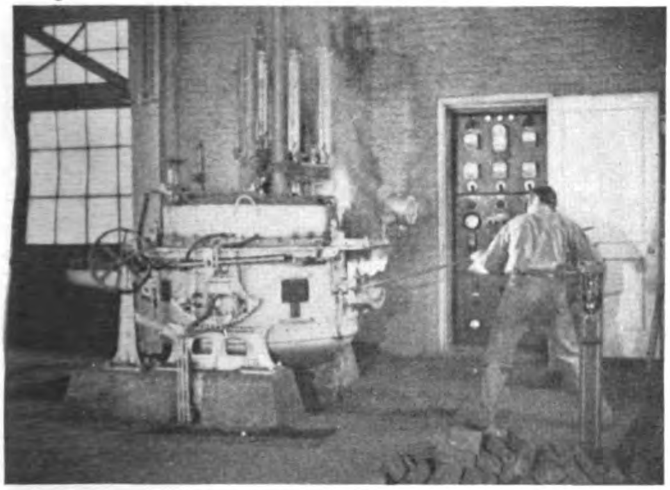
◆

Welding and Cutting Apparatus and Supplies.—Air Reduction Sales Co., 60 East Forty-second street, New York. Catalog 22, 32 pages. Depicts hand welding and cutting torches and tips, pressure regulators, fluxes, rods and other supplies, and complete outfits for industrial uses.—Catalog 21, 64 pages. Contains, in addition to those items in Catalog 22, other information dealing with acetylene generators, industrial gases and oxy-acetylene machines, with several pages devoted to pipe-line safety devices, two pages on National Carbide and two on Wilson arc welders.

RAILWAY MECHANICAL ENGINEER

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal and Railway Master Mechanic. Name Registered, U. S. Patent Office.



In the laboratory of the Association of Manufacturers of Chilled Car Wheels—Metallurgical research is facilitated by an electric furnace with a capacity for casting two full-size wheels

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February, 1939

Volume 113 *No. 2*

General:

Locomotives:

Cars:

Editorials:

Car Foremen and Inspectors:

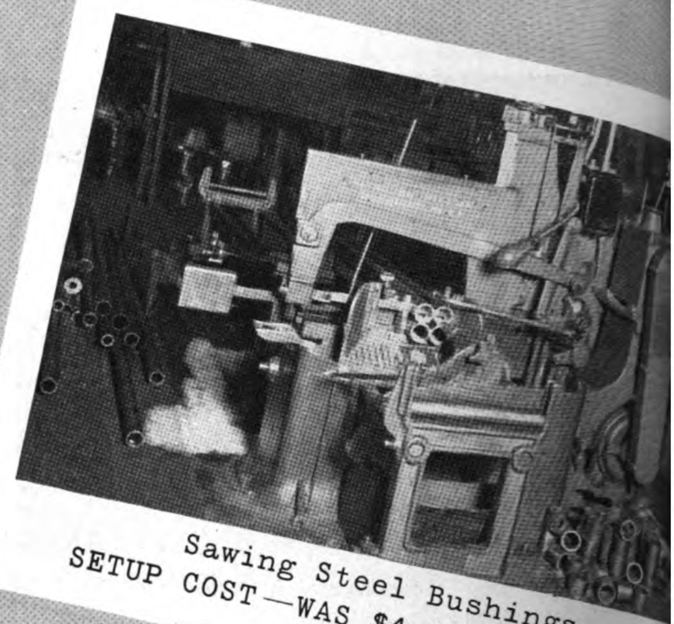
Back Shop and Enginehouse:

ARE YOUR BACK SHOPS MAKING THESE SAVINGS?

THESE typical jobs, done with modern machinery, were snapped during a trip through a number of railroad shops. The savings were estimated by shop men on the job.

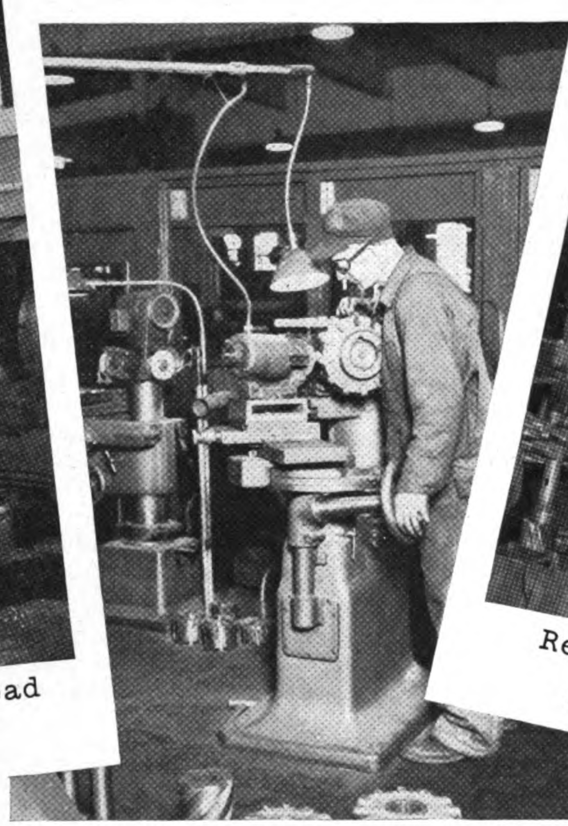
Modern machine tools like these not only cut costs but also gear your back shops for the high-precision work required on modern motive power.

G-E electric drive is used on these machines and for many other shop applications. Smooth and accurate in action and thoroughly dependable in operation, this drive permits releasing your locomotives more quickly from the back shop for more revenue-miles on the road. General Electric, Schenectady, N. Y.

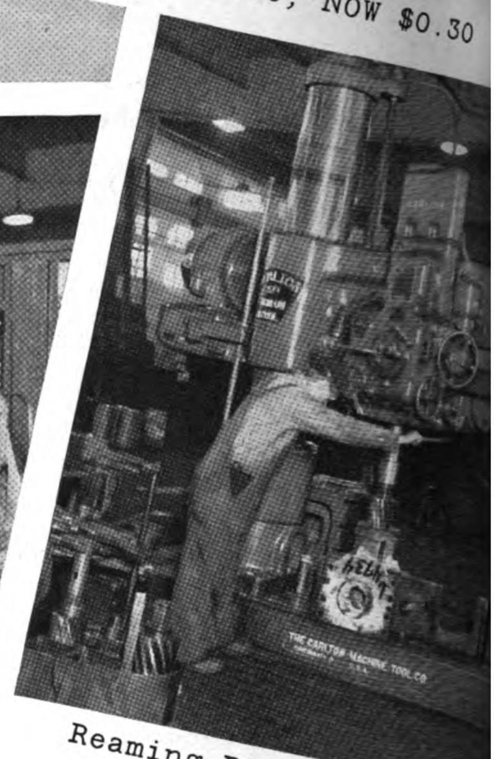


Sawing Steel Bushings
SETUP COST—WAS $4.00; NOW $0.30

Drilling a Steel Crosshead
SAVING—35% to 40%



Sharpening Tool-steel Cutters
SAVING—30% to 40%



Reaming Piston-rod Fit
SAVING—20% to 25%

GENERAL ELECTRIC

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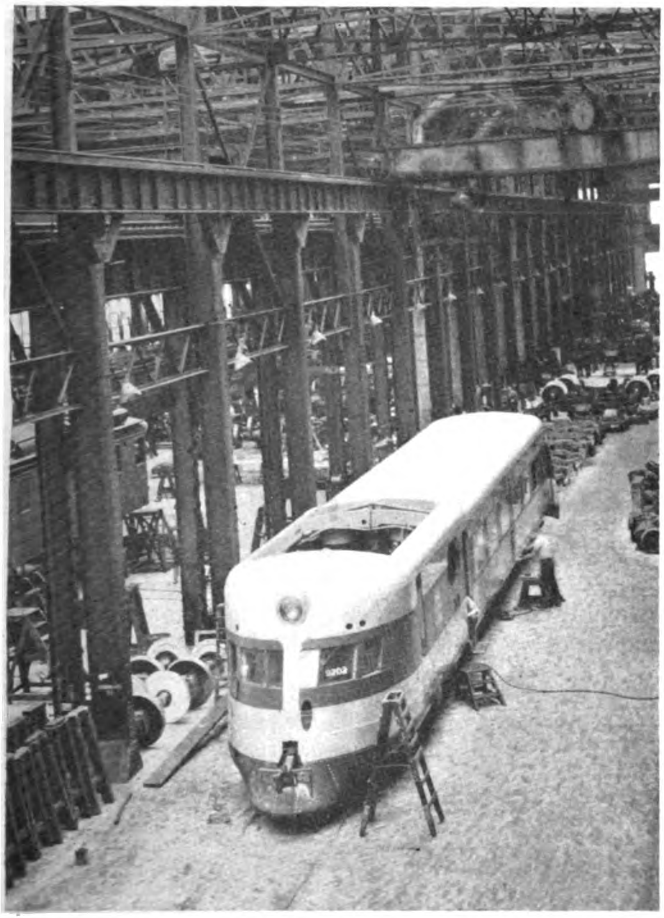
RAILWAY MECHANICAL ENGINEER

General Overhaul of the

New Haven Comet



One of the three units of the Comet at Van Nest Shop

By P. H. Hatch*

The first general overhaul of the three-car Diesel-electric train at the end of three years of service, during which time it ran 405,000 miles, reveals many interesting facts concerning the operation of power plants and auxiliaries

In a previous article appearing in the January, 1937, issue of *Railway Mechanical Engineer,* the results of the first year of operation of the New Haven Comet were described. The train has now passed its three-year mark and on November 1, 1938, was released from its first general overhaul after making 405,000 miles in service. In the course of this work the train was almost entirely dismantled, so that an excellent opportunity was afforded for detailed inspection of the equipment, as a result of which many interesting and in some cases unsuspected facts and conditions were brought to light.

Since the type of service operated has a direct bearing on equipment performance, the results of the general overhaul were additionally significant by reason of the fact that during the preceding nine months the duty imposed on the Comet was the severest in its history.

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Due to the re-arrangement of service in the Boston-Providence territory in September, 1937, several steam trains were discontinued and The Comet's schedule was altered to provide substitute and in some cases additional service. This has resulted in increased patronage for the train, but has involved operating it in what might be called "local express" service for a majority of its trips. At the present time only two of the 10 single trips week-days between Boston and Providence involve the old schedule of 44 minutes for a 44-mile run including two intermediate stops; two other trips involve a total of three intermediate stops with schedule lengthened to 48 minutes; the remainder involve five stops with a 55-minute schedule. On Sundays four round trips or eight single trips with five stops and a 55-minute schedule are operated. Special Sunday excursions have been eliminated, and The Comet is now in regular operation both week-days and Sundays.

It can readily be appreciated that the assignment of a train designed for high-speed operation to local express runs with frequent stops imposes a greatly increased duty on its motive power equipment. This has been reflected in increased fuel consumption and decreased brake-shoe and wheel mileage as well as in less tangible factors.

The ordinary maintenance of the train is handled at Boston at night. A special force has been organized and is assigned exclusively to the Comet work. Weekly inspections are performed progressively throughout the week; monthly and I. C. C. inspections are handled as a unit one day a month, the train being taken out of service for this purpose.

Due both to the desirability of a complete check-up of the condition of the train as well as to the actual state of the Diesel engines after 3¼ years of operation and 405,000 miles, a general overhaul was scheduled for the summer of 1938. Van Nest shop (New York City), the central point for repairs to main-line electric locomotives

The parts of the two Diesel engines of the Comet were completely dismantled—These, together with some truck parts, are shown in the shop while undergoing repairs

and multiple-unit cars, as well as Diesel-electric switching locomotives, was selected as the logical place for the Comet general overhaul and accordingly, on July 3, 1938, the train was moved under its own power to that shop.

Preparations for the General Overhaul

Several months previous to the actual shopping, the groundwork for the overhaul was laid. It was known in advance that certain work would be necessary; conferences were held with the local forces to develop additional items, supplemented by actual inspections of different parts of the train. From these various sources it was possible to make up a comprehensive work schedule and requisition the necessary material.

The unknown quantities, of course, were what conditions would be found when the equipment was dismantled and what material would then be required. It was on this account, therefore, that efforts were directed toward as prompt and systematic disassembly of apparatus as possible.

While the shop forces were in most cases familiar with the different kinds of work required, they were totally unfamiliar with the particular details of the work peculiar to the Comet. For example, there was in general nothing new about the truck work; specifically, however, there were the shock-absorber units of the trucks which required entirely new and unfamiliar treatment. The same was true of Diesel engines, electrical control, heating boiler, and so on.

Hence when the schedule of general overhaul items was completed, a meeting was held with those who were to assist in general supervision, and each man was assigned those items in his particular field. Similar assignments were subsequently made to the shop supervisors who were at the same time informed to whom to look for general supervision in carrying out various classes of work. This procedure was of great assistance in overcoming the general obstacle of unfamiliarity.

The General Overhaul

The general overhaul work got under way on July 5. The first main activity undertaken was separating the three cars and placing them on dummy trucks to facilitate their movement about the shop. This was the first time since the train was built that this was done and it afforded an opportunity to inspect the articulation connections. Engine-room hatches were lifted off and Diesel engines, electrical equipment, air compressors, battery, heating boiler, etc., were removed. Seats and interior fittings were removed from the car bodies. In other words, nearly all important items of equipment were taken out and sent to the respective departments in the shop for attention.

Under the following headings is given an outline of the work involved on various major parts of the train or its equipment.

Diesel Engines*

The largest single item of work on the Diesel engines was the reconditioning of crankshaft journals and pins. After some investigation a local company was found which had grinding equipment suitable for the shafts in question and which furthermore had had extensive experience in such work, and after removal both crankshafts were boxed and shipped to this company. Table I shows the diameters of individual crankshaft journals and pins of both engines before reconditioning and Table II the clearances at the pins and main bearings.

The pins and main journals of the No. 1 engine crankshaft were both ground .025 inch undersize; the pins of the No. 2 engine crankshaft were ground .025 inch undersize and the main journals .035 inch undersize.

It is believed that on completion of the work the crankshafts were fully as accurate as when new.

Table III gives the clearances as found at the crankpins and main bearings of the two engines.

The main bearings, particularly in the No. 2 engine, were found to be in need of replacement. The crankpin bearings, on the other hand, came through the 3¼ years in excellent condition in both engines.

The new undersize main bearings purchased were lined with a special soft babbitt in accordance with the manufacturer's latest design. The new undersize crankpin bearings were lined with the same grade of babbitt as formerly. Special arrangements were made for boring both main and crankpin bearings to size. For the former a boring bar was made up, and a vertical milling machine, formerly used for milling slots in the stators of single phase motors used in the original New Haven electric passenger locomotives, was adapted for use with it.

* The Comet is equipped with two Westinghouse six-cylinder, four-cycle Diesel engines developing 400 hp. at 900 r. p. m. The cylinder size is 9 in. by 12 in. A complete description of the train appeared in the *Railway Mechanical Engineer* for May 1935, page 185.

This made an excellent combination and produced very satisfactory results.

For boring the crankpin bearings, a jig was made to hold the connecting rod with the bearing so that each one could be bored to the same dimension from center of the piston pin bushing to the center of the bearing, thus maintaining the correct stroke throughout.

Table I — Crank Pin Measurements

CRANK PIN DIAMETERS, INCHES

Crank Pin No.	No. 1 Engine 1	2	3	4	5	6	No. 2 Engine 1	2	3	4	5	6
Front Vertical	4.996	4.9955	4.9965	4.995	4.994	4.995	4.992	4.993	4.9925	4.995	4.991	4.994
Front Horiz.	4.997	4.998	4.9975	4.998	4.996	4.9975	4.997	4.996	4.9945	4.997	4.997	4.994
Rear Vertical	4.996	4.9965	4.9965	4.9955	4.994	4.996	4.994	4.991	4.994	4.9935	4.9895	4.9935
Rear Horiz.	4.9975	4.9985	4.9985	4.9975	4.9965	4.998	4.996	4.997	4.995	4.9965	4.997	4.9945
Initial (actual)	4.999	4.999	4.999	4.999	4.999	4.999	4.999	4.9995	4.9995	4.999	4.9995	4.999

No. 1 Engine: Maximum diametral wear, .005 in.; Maximum out-of-round, .003 in.

No. 2 Engine: Maximum diametral wear, .010 in.; Maximum out-of-round, .0075 in.

Table II — Main Bearing Measurements

MAIN BEARING JOURNAL DIAMETERS, INCHES

Bearing No.	No. 1 Engine 1	2	3	4	5	6	7	No. 2 Engine 1	2	3	4	5	6	7
Front Vertical	4.9965	4.9965	4.997	4.9935	4.997	4.997	4.996	4.999	4.996	4.991	4.988	4.993	4.995	4.999
Front Horiz.	4.9985	4.997	4.996	4.998	4.996	4.995	4.997	4.998	4.9965	4.996	4.9995	4.997	4.9955	4.997
Rear Vertical	4.996	4.9965	4.9945	4.995	4.996	4.996	4.996	4.998	4.997	4.9895	4.9905	4.994	4.9955	4.997
Rear Horiz.	4.998	4.9985	4.998	4.998	4.996	4.9965	4.9965	4.9905	4.997	4.997	4.998	4.9965	4.997	4.9965
Initial (nominal)	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000

No. 1 Engine: Maximum diametral wear, .0065 in.; Maximum out-of-round, .0045 in.

No. 2 Engine: Maximum diametral wear, .012 in.; Maximum out-of-round, 0.115 in.

Table III — Bearing Clearances

	No. 1 Engine 1	2	3	4	5	6	7	No. 2 Engine 1	2	3	4	5	6	7
Crankpin (on top center)	.005	.005	.003	.007	.007	.008	...	.005	.004	.008	.008	.006	.009	...
Main (maximum)	.012	.015	.013	.022	.012	.013	.015	.019	.0125	*	*	*	.012	.011

* Defective babbitt prevented taking correct measurement.
Note: Dimensions given are in inches.

When being assembled for boring, all bearings were set up with proper thickness of shims.

Due to weakness in design of the original type cylinder liners, they had been replaced with new design liners with a nominal bore of 8⅞ inches instead of the original bore of 9 inches. Likewise pistons with the so-called dish tops had replaced the old type pistons and turbulence rings. These changes having been made within a year or so, nothing of any special significance was developed by the overhaul regarding liner and piston life except the general conclusion that liner wear appeared to be satisfactory with the piston-ring arrangement used. The latter has been changed and it is expected that improvement both in wear and lubricating-oil consumption will result. In brief, this arrangement consists of tapered compression rings with bronze inserts in the two top grooves, plain tapered compression rings in the next three grooves, and oilcutter rings in the two bottom grooves.

The principal cylinder-head activities consisted of the renewal of rocker-arm bushings and valve guides, grinding of valves and resurfacing of valve seats. The decompression lever arrangement on the engines was discontinued.

Camshafts were removed and inspected and found to be in good condition with very little cam wear. Camshaft bearings were in good shape.

Gear-train back lash was encountered in both engines, but after renewal of worn bushings it was reduced to such an extent that it is expected the present gears can be continued in service until the next general overhaul.

The hydraulic governors and timing governors were completely dismantled and new parts installed as dictated by amount of wear found. A new ball thrust bearing arrangement was applied to the timing-governor spline shaft on account of frequent failures of the old type bearing.

New high-pressure fuel-injection pumps were installed at the previous annual repair shopping, and hence beyond a thorough checking of drive, control, eccentrics, connecting rods, by-pass valves and check valves the assemblies were not disturbed. At the conclusion of the repairs, of course, all pumps were set and adjusted for correct start and duration of injection. Nozzles were cleaned, tested and adjusted as necessary.

All water and lubricating-oil radiators were removed, tested and thoroughly cleaned. They were found to be in generally good condition with the exception of a few easily repaired leaks. Lubricating oil piping, in particular, was cleaned by pumping a special hot solution through it to remove the carbon coating on the interior.

Lubricating-oil gear pumps were removed and new gears and other parts installed. A new impeller, shaft and packing were installed in the No. 1 engine water pump; a new shaft and packing in the No. 2 engine pump.

In order to correct somewhat excessive corrosion in spots in the water spaces of the engines, the water treatment previously used was intensified and the spots were filled in with compound.

The exhaust-manifold muffler on the No. 1 engine had been fitted with a sheet metal housing arranged to be ventilated by the ejective action of the exhaust gases. This was applied two years ago in the attempt to reduce the temperature of the engine room and of the battery electrolyte. While the battery temperature has since been materially reduced by other means, nevertheless tests showed that the muffler housing had actually reduced the engine-room temperature somewhat, and it was thought that by keeping a more constant temperature on the muffler itself, expansion with consequent cracking had

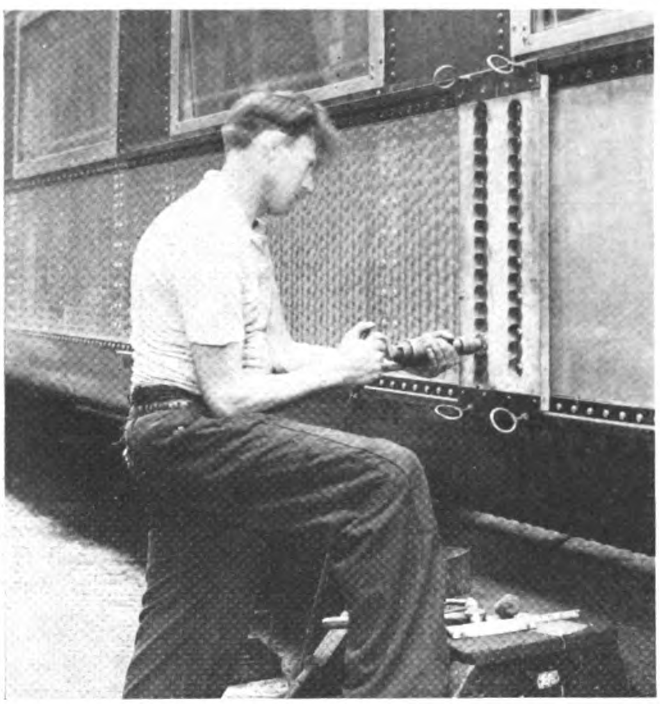
also been reduced. Hence during the general overhaul, a similar housing was applied to the exhaust-manifold muffler of the No. 2 engine.

Previously the crankcase breather pipe on both engines was led directly to the outside under the train. This made one more source of oil drip underneath and in case of any visible vapors made an unsightly appearance at stations. During the general overhaul this was corrected by leading the breather into the air intake manifold on each engine.

Another improvement was the installation of separate drain lines into the fuel tank at each end for low-pressure regulating valve spillover and high-pressure nozzle spill-over. The previous arrangement resulted in undesirable oil leaks and dilution.

Electrical Equipment

The main and auxiliary generators were removed for commutator turning, cleaning and painting of the armatures, fields and leads and dismantling and inspection of bearings. The No. 1 main generator ball bearing was renewed because of the condition of the outer race.



The "whirled" finish on the sides being put on with an air tool

All traction motors, including the spare, had gone through the shop within a year for commutator turning and installation of roller armature bearings. Hence at the overhaul, it was necessary only to clean and inspect them and to check the bearings.

Radiator fan motors, air compressor motors and Freon compressor motors were removed for general attention including turning of commutators.

Small auxiliary motors for evaporator fans, exhaust fans, fuel transfer pumps, boiler-water pump, boiler burner and boiler oil pump were removed and overhauled, as was the boiler-control ac-dc motor generator set.

Relays were removed, overhauled, tested and adjusted, as were contactors, unit switches and reversers. Master controllers were inspected in place.

Some wiring was renewed, principally on account of deteriorated insulation due to being subjected to external heat, such as engineroom lighting wiring, resistor connections and wiring for throttle operators, trips, etc., on the engines. Oil-soaked leads were cleaned and general attention was given as required to all exposed wiring and cable in the way of renewal of insulation, cording and protection against chafing.

Storage Battery

On test discharge the battery was found to have approximately 85 per cent of rated capacity. Internal inspection of some cells, however, indicated the need for special treatment if another year's service were to be obtained. Hence the 56 cells were sent to the manufacturer's service station where the necessary attention was given them. This included the renewal of six cells of very low capacity with used cells in good condition after which slightly over 100 per cent capacity was obtained on test discharge. Thus it is believed that satisfactory service will be obtained for the next year although it will probably be necessary to purchase a new battery at the next annual repairs to the train.

Mention has already been made in this and the previous article on The Comet of the unsatisfactory battery conditions which were found to exist. These were first laid to high engine-room temperatures, but a subsequent thorough investigation and analysis showed conclusively that lack of proper control of charging rates was mainly responsible. This has been remedied by the installation of voltage regulators to hold charging voltages at idling to its proper value. Hence, while as mentioned previously, it will no doubt be necessary to renew the entire battery next year after a life of almost 4½ years, it is expected that the new battery will have a much better chance to realize a long life in Comet service.

Speedometer

The experience with the speedometer equipment had been rather unsatisfactory. Lack of permanency of adjustment and inconsistency of indication were the principal troubles. Accordingly the speedometer was returned to the plant of the manufacturer for checking and repairs, the latter including modernization in certain important respects. Experience in service so far shows considerable improvement.

Air Brake Equipment

All major items of the air brake equipment were removed for repairs and testing. Both Decelakrons were inspected and adjusted for proper deceleration settings. Necessary minor repairs were made to the air compressors.

Doors and Door Control

Opportunity was afforded for thorough inspection of door engines and door- and step-operating mechanisms. Cup leathers were renewed and bleeder cocks ground in. New and larger pins were installed in the levers, and magnet valves, interlocks, indicating lights, switches, etc., were inspected. Leads to the outside door switches from junction boxes under the floor were renewed.

The train was originally equipped with rubber step treadles with a contact-making arrangement so connected that a door could not be closed with anyone standing on the folding steps or if a door were starting to close, any weight on the treadles would immediately open the door and let down the steps. Because of difficulty in keeping them waterproof, however, and operating on a relatively high voltage for door-control circuits, these treadles frequently grounded and occasionally set up false circuits which were extremely troublesome. For instance, while the train was in motion a door and steps might open

which would stop the train, but in some cases not before the steps had fouled an intertrack fence, dwarf signal or some similar wayside object. Furthermore, since the door circuits were connected to the main control circuits of the entire train, it was highly undesirable to have any grounds whatever in any part of the system. Hence in view of the fact that other and more effective safety devices were already in service, it was decided to disconnect the door treadles entirely. This had been done some time previously, but at the general overhaul the old rubber treadles were replaced by aluminum step treads with suitable anti-slip pattern. These are much neater in appearance, and should outlast the former treadles with less maintenance.

The passenger-compartment door checks had given considerable trouble with wear of the bolts used to hold the doors in the open position. These checks were renewed and changes were made by the manufacturer which have definitely improved their operation.

Air-Conditioning Apparatus

Except for the completion of the relocation of fluid control valves in the car vestibules to make them more accessible, only routine attention was given for the most part to the air conditioning apparatus.

Boiler and Control

The heating boiler was removed and given general repairs. A new and improved firebox was installed.

The automatic control equipment for the boiler was inspected and repaired. The motor-generator set was moved to a more suitable location away from the fire door.

Steam train-line expansion joints were repacked and regulators were dismantled, repaired and adjusted.

Truck Repairs

Both motor and articulation trucks were completely dismantled. Motor-truck wheels had been renewed late in the previous spring and at the general overhaul the contours were restored; articulation truck wheels were renewed. All roller bearings were removed and inspected by manufacturers' representatives.

The center-plate assembly in the motor trucks was of special design and made use of rubber units and plates of special material. Experience in service was not very satisfactory and it was replaced with a more conventional arrangement which gave much better results. Articulation-truck center plates were of generally similar construction and these were modified at the general overhaul.

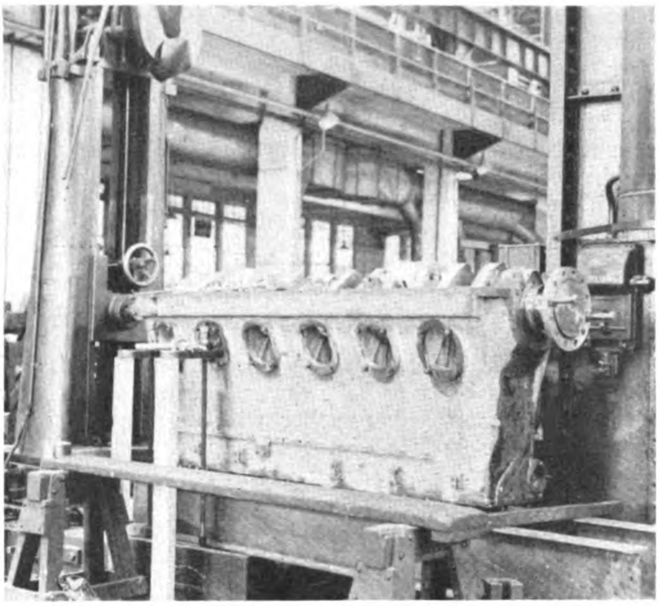
Repairs were made to the motor nose supports, wear plates were renewed as necessary, brake rigging and other pins and bushings were replaced and other truck maintenance of a routine nature was attended to. Motor-axle bearings were rebabbitted. Four new design slack-adjuster engines were installed for test, one on each truck.

Probably the center of interest in the Comet trucks is the shock absorbers. Each of these, it will be recalled, is fastened at the top to the truck frame and at the bottom to one end of the equalizer supporting the truck bolster. They hang at an unusually wide outward angle compared to the conventional bolster hangers. The shock absorbers themselves are the same type as used for airplane landing gear. In brief they consist of an inner and outer coil spring with hydraulic damping. The fluid used is a half-and-half solution of alcohol and castor oil, the former being added to obtain fluidity in cold weather.

After the second year of service, the shock absorbers were returned to the manufacturer for inspection and repairs. Many of their parts were found to be in such condition that annual dismantling and inspection was decided upon thenceforth.

Accordingly the railroad made up the necessary tools for this and at the general overhaul the eight motor truck and eight articulation truck absorbers were disassembled. All of the main springs were found to be in excellent condition. The top spring retainers, however, had rubbed against the ground portion of the piston rods to such an extent that eight rods required building up to their original diameter in order to maintain the effectiveness of the leather packing preventing loss of fluid. Chromium plating was resorted to for this restoration. Most of the wear had taken place on the top sides of the rods due to the angle of suspension of the absorbers.

Various means of eliminating this wear were studied since the need for building up was becoming an annual occurrence and would eventually mean the scrapping of the rods, to say nothing of the expense and trouble encountered each year. Spring retainers made of high-tensile aluminum bronze were eventually decided upon



Line-boring the main bearings of one of the Diesel engines

and manufactured, the design being changed so that the surface in contact with the rods provided as great a bearing area as possible. Experience in service with the new type retainers will be watched with great interest.

The Superstructure

Car Bodies

The Comet is essentially an aluminum train. With the separation of the cars and the removal of equipment incident to the general overhaul, a careful check was made to determine if corrosion of any aluminum parts had occurred. Only a few instances were found and these in relatively unimportant locations, so that the train was given a clean bill of health in this regard. The spots in question were treated with a special corrosion-resistant paint for aluminum recommended by the manufacturer.

The condition of the interior finish of the cars between the windows and floor and on some of the bulkheads made it necessary to replace it during the overhaul. The basic cause of the trouble was moisture, either from natural sweating or steam leaks, or both, the result being a blistered and spotted surface here and there,

with numerous holes punched through. The removal of the finish provided an opportunity to check the condition of the aluminum foil insulation which was found to be excellent.

New rubber flooring was applied to the aisle of the center car, and other rubber flooring was repaired as necessary. New rubber mats were installed in the vestibules.

Painting and Exterior Finish

The Comet was completely repainted inside and out. Except for the so-called "whirled" finish of the aluminum sheets on the outside no particular problems were encountered.

When the train was built, the surfaces corresponding to the letter board on conventional cars and the side sheets under the windows were left in natural aluminum color. To heighten the effect these surfaces were given a whirled finish consisting of overlapping circles, which, when varnished and waxed, presented a striking and at the same time pleasing appearance. This finish, however, has been very difficult to maintain, the reason being that the protective varnish and wax coating has worn through in places, particularly where subjected to the action of snow and rain at high speeds or constant wiping where fuel or lubricating oil spilling has occurred at or near the filling points. An aluminum surface, particularly one that has been roughened by the whirling process, oxidizes very readily, with the result that the whirled finish had disappeared completely in spots. At various times in the past these spots have been patched up with new whirling, but by the time of the general overhaul considerable attention was necessary.

All of the side sheets were re-whirled, and for this a guide for the whirling tool was made up and arranged so that it could be slid along the surface on tracks bolted to the top and bottom of the sheets. An air motor with a fibre disc was used, together with an abrasive compound for the surface of the disc in contact with the sheets. One of the illustrations shows the whirling process under progress on one of the cars. While a fairly neat job could be done in this manner, it was very expensive and was not equal to the original finish which was given to individual flat aluminum sheets before application to the train.

Water Storage Tanks

Diesel-engine sub-base, water, fuel-oil and lubricating-oil storage tanks and car structure beneath the engine room are all combined into an integral, built up bed plate at each end of the train. In the No. 1 end, the water tank is used for service water which is pumped to the saloons; in the No. 2 end, it is used for boiler feed water.

Almost from the time the train was first put into service there were complaints of discolored water in the wash bowls. The bed-plate tank was frequently flushed and cleaned, but the discoloration persisted. One of the principal items in the general overhaul schedule was the investigation of both water tanks with the object of eliminating the corrosion which obviously must be taking place.

When the Diesel-engine generator sets were removed, therefore, both tanks were thoroughly inspected. Sufficient evidences of corrosion were found to make it absolutely necessary to arrest it immediately since otherwise weakening of the train structures in both ends would ultimately result, aside from continued trouble with rusty service water from the tank at No. 1 end.

Whereas it was practicable to treat the boiler feed water in the No. 2 end tank for absorption of free or dissolved oxygen, using conventional methods and materials, the addition of any chemicals to service water was definitely undesirable. Hence, after considerable investigation, it was decided to install an overhead service water tank of copper for the two saloons in the end of each motor car, the water to be fed by gravity which would permit the discontinuance of the electrically driven service water pump and water line through the train. Under these conditions, the bedplate tank formerly used for service water was cleaned, its interior was coated with fuel oil and it was permanently sealed up.

To protect the bedplate tank used for boiler water, arrangements were made for intensive treatment along the lines described. To assist in thorough cleaning prior to this, as well as in the future, a number of additional hand holes were cut in the top of this tank.

Miscellaneous

Additional drains, connected to the original drain pipes were installed in the wells under each generator.

Additional drainage holes were installed in the "underskin" of the train.

Threshhold plates at articulation connections were renewed and revised method of securing applied.

Testing

To provide convenient, inexpensive and accurate means for testing and adjusting Diesel-electric equipment at Van Nest shop, a water rheostat had been built with ample continuous capacity for any of the equipments in service. This was utilized for testing the Comet and proved its worth many times over. It would have been almost impossible to have done the work adequately without it. The number of road tests that would have been required to obtain the same variety of loads easily and quickly available by means of the water rheostat would have been prohibitive in both expense and time. As it was, only one road test was required and this for the purpose of testing general operation of the train as a whole.

In conjunction with the loading provided by the water rheostat, pyrometer equipment for measuring exhaust gas temperatures and a maximum-pressure indicator for determining cylinder pressures were utilized to check conditions in each cylinder of the Diesel engines and to balance them as necessary.

In brief, the testing procedure for each engine included a careful adjustment of high-pressure fuel pumps for correct timing and duration of injection. After prolonged running-in of both engines, the hydraulic governors were adjusted for correct engine speeds, after which the electrical governors, or speed-control apparatus, were set for proper engine loading in the running notches.

At the conclusion of the tests, the operation of the engines appeared to be exceptionally smooth. Plenty of power was available in each, the fuel stops being adjusted to limit the output to rated value. Exhaust conditions were better than ever, and lubricating-oil and water temperatures were well within the proper ranges.

During and in between the Diesel engine testing, the boiler and train-heating equipment were tried out, as were the door and step operating mechanisms and control, air-conditioning and ventilating equipment, lighting, etc. The testing of the air-brake system had been for the most part completed.

Before the final release of the train, a road test was arranged for the purpose of checking trucks, bearings and riding qualities. During the test, 155 miles were run at speeds starting around 15 m. p. h. and being progressively increased to a maximum of 87. Performance, with the exception of two or three instances of a

(Continued on page 61)

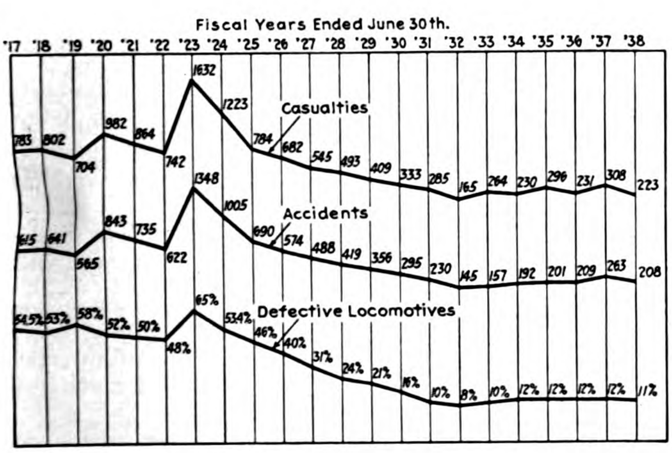
Annual Report of the Bureau of

Locomotive Inspection

Report of inspections of steam locomotives shows that 5.1 per cent more inspections were made and defects decreased 15 per cent

THE annual report of the Bureau of Locomotive Inspection, Interstate Commerce Commission, submitted by John M. Hall, chief inspector, covering the fiscal year ended June 30, 1938, shows an increase of 5,153 locomotives inspected as compared with the previous year; a decrease of 1,352 in the number of locomotives found defective; a decrease of 1 per cent in the number inspected and found defective; a decrease of 255 in the number ordered out of service, and a decrease of 7,532 in the total number of defects found. The above figures apply only to steam locomotives.

The accompanying chart shows the percentage of defective locomotives, the number of accidents and the number of casualties for the fiscal years ended June 30, 1917, to 1938, inclusive. Summaries and tables included in the report show separately accidents and other data

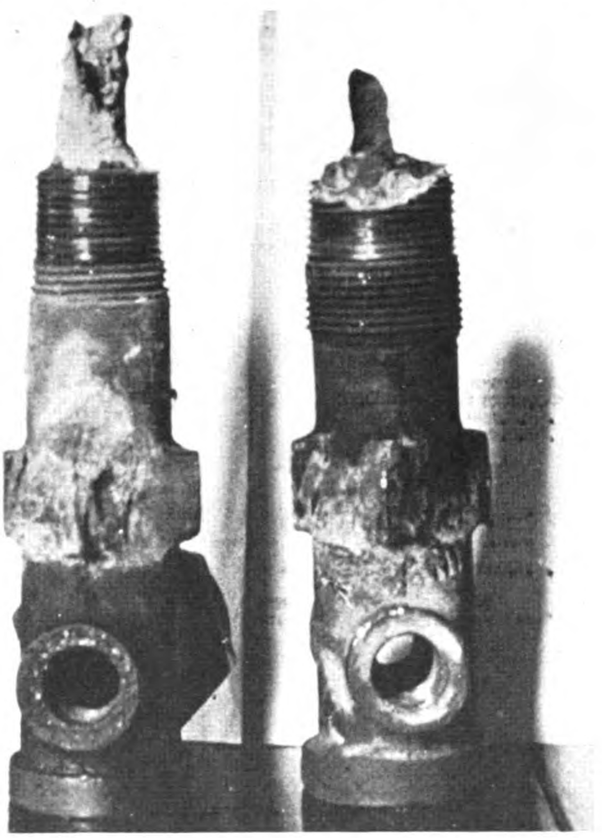


This chart shows the situation as to accidents, casualties and defective locomotives over a 22-year period

in connection with steam locomotives and tenders and their appurtenances, and accidents and other data in connection with locomotives other than steam.

In addition to the accidents shown in the tables and otherwise referred to in this report there was reported to the bureau a total of 84 accidents in which 7 employees were killed and 77 employees injured in falls while in the performance of their duties on locomotives. None of these falls could be attributed to the condition of the locomotives, it being apparent in each instance that the falls were caused by inattention or sudden illness on the part of those killed and injured. These accidents do not come within the scope of the locomotive inspection law, but were mentioned in the report in order to emphasize the necessity of alertness on the part of all persons employed on or about locomotives.

Another case of low water resulting in the death of an employee. The force of the explosion hurled the boiler 200 ft.



Condition of two bottom water glass cocks as found by inspector. The extension into the water space in each case was corroded and in one case it affected part of the threads

During the fiscal year ended June 30, 1938, the number of steam locomotives inspected totaled 105,186, of which 11,050, or 11 per cent, were found defective, and 679 were ordered out of service. In 1937 there were 100,033 steam locomotives inspected, of which 12,402 were found defective and 934 ordered out of service. In the year ended June 30, 1936, a total of 97,329 loco-

Number of Steam Locomotives Reported, Inspected, Found Defective, and Ordered from Service

Parts defective, inoperative or missing, or in violation of rules	Year ended June 30—					
	1938	1937	1936	1935	1934	1933
1. Air compressors	689	766	740	733	660	474
2. Arch tubes	66	105	74	74	127	51
3. Ashpans and mechanism	72	80	79	94	87	40
4. Axles	13	10	13	10	6	21
5. Blow-off cocks	226	199	236	283	289	210
6. Boiler checks	301	382	356	413	407	293
7. Boiler shell	331	347	383	396	372	296
8. Brake equipment	2,044	2,322	2,480	2,449	2,326	1,696
9. Cabs, cab windows, and curtains	1,226	1,807	1,638	1,273	1,342	1,183
10. Cab aprons and decks	326	466	450	368	343	309
11. Cab cards	109	145	166	142	129	121
12. Coupling and uncoupling devices	73	74	65	73	54	67
13. Crossheads, guides, pistons, and piston rods	905	1,160	1,056	1,086	1,100	773
14. Crown bolts	59	76	63	75	77	67
15. Cylinders, saddles, and steam chests	1,645	2,206	1,717	1,547	1,491	1,084
16. Cylinder cocks and rigging	585	729	605	627	654	374
17. Domes and dome caps	109	101	114	94	105	76
18. Draft gear	740	522	513	423	401	318
19. Draw gear	479	560	451	414	480	357
20. Driving boxes, shoes, wedges, pedestals, and braces	1,688	1,637	1,712	1,573	1,472	1,080
21. Firebox sheets	244	371	295	343	356	246
22 Flues	159	225	178	173	203	150
23. Frames, tail pieces, and braces, locomotive	1,001	1,053	997	1,006	951	669
24. Frames, tender	131	120	113	124	128	80
25. Gages and gage fittings, air	230	261	257	275	212	145
26. Gages and gage fittings, steam	279	324	350	320	289	258
27. Gage cocks	451	538	579	480	384	388
28. Grate shakers and fire doors	403	470	400	394	404	245
29. Handholds	405	510	502	464	377	363
30. Injectors, inoperative	26	38	40	39	33	20
31. Injectors and connections	1,784	2,020	2,085	2,035	1,909	1,357
32. Inspections and tests not made as required	8,204	9,638	9,005	8,344	8,173	6,358
33. Lateral motion	325	446	404	389	351	269
34. Lights, cab and classification	48	90	78	81	79	76
35. Lights, headlight	257	313	251	257	218	169
36. Lubricators and shields	212	254	255	191	215	157
37. Mud rings	203	272	237	241	247	232
38. Packing nuts	448	487	508	527	491	419
39. Packing, piston rod and valve stem	913	1,393	1,133	906	833	592
40. Pilots and pilot beams	154	133	178	152	174	123
41. Plugs and studs	238	238	236	167	242	151
42. Reversing gear	404	492	463	414	390	254
43. Rods, main and side, crank pins, and collars	1,669	2,348	2,093	1,826	1,670	1,327
44. Safety valves	125	132	125	100	108	53
45. Sanders	536	655	678	779	697	376
46. Springs and spring rigging	2,901	3,172	3,008	2,765	2,854	2,122
47. Squirt hose	94	133	134	113	107	93
48. Stay bolts	211	276	279	240	285	219
49. Stay bolts, broken	380	542	520	512	455	368
50. Steam pipes	410	446	526	463	489	338
51. Steam valves	141	165	227	212	267	193
52. Steps	631	678	615	640	567	498
53. Tanks and tank valves	955	1,009	877	913	862	600
54. Telltale holes	67	79	127	102	93	90
55. Throttle and throttle rigging	685	909	760	733	639	448
56. Trucks, engine and trailing	762	785	861	811	898	664
57. Trucks, tender	907	1,018	1,108	1,120	918	747
58. Valve motion	722	798	824	799	784	640
59. Washout plugs	626	598	714	679	776	623
60. Train-control equipment	11	12	6	4	8	4
61. Water glasses, fittings, and shields	915	1,049	1,118	951	907	716
62. Wheels	577	803	790	697	734	580
63. Miscellaneous — Signal appliances, badge plates, brakes, (hand)	684	759	608	563	572	423
Total number of defects	42,214	49,746	47,453	44,491	43,271	32,733
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Locomotives defective	11,050	12,402	11,526	11,071	10,713	8,388
Percentage of inspected found defective	11	12	12	12	12	10
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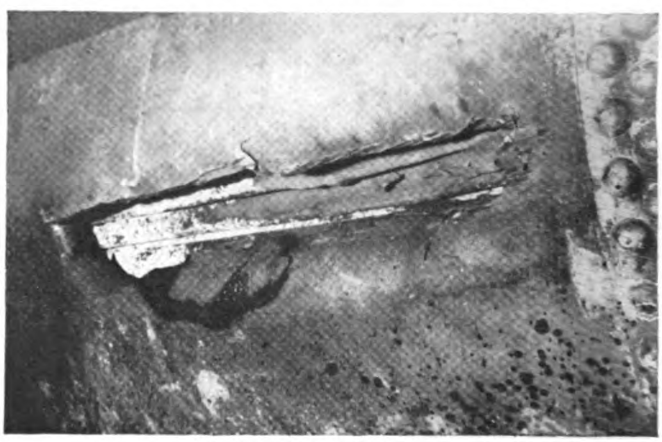

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Under Rules 328 and 329 of the Rules and Instructions for Inspection and Testing of Locomotives Other Than Steam, 228 specifications and 51 alteration reports were filed for locomotive units and 98 specifications and 45 alteration reports were filed for boilers mounted on locomotives other than steam. These were checked and analyzed and corrective measures taken with respect to discrepancies found.

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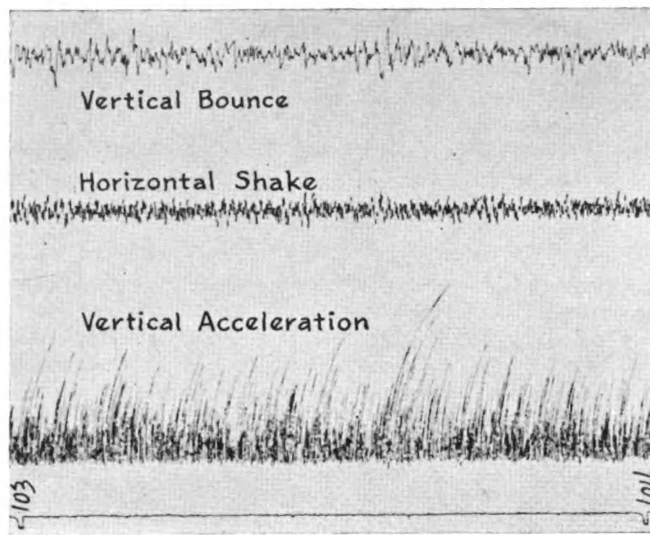
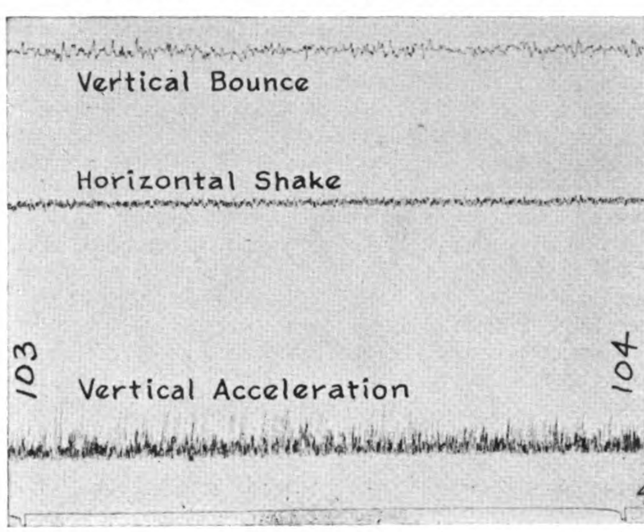


A-1 wedge type buffer—54.5 m. p. h., November 21, 1938



E-2 type radial buffer—54.6 m. p. h., November 23, 1938. (Same locomotive as above)

Sections from shock and vibration recorder tapes showing the effect of the spring-actuated friction-type radial buffer in steadying the riding of the locomotive

Heretofore, the mechanism used between engine and tender has been the wedge type radial buffer, or the spring buffer types, the inadequacy of which became pronounced with the advent of higher speeds.

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Number of Steam Locomotives Reported, Inspected, Found Defective, and Ordered from Service

Parts defective, inoperative or missing, or in violation of rules	Year ended June 30— 1938	1937	1936	1935	1934	1933
1. Air compressors...	689	766	740	733	660	474
2. Arch tubes	66	105	74	74	127	51
3. Ashpans and mechanism	72	80	79	94	87	40
4. Axles	13	10	13	10	6	21
5. Blow-off cocks	226	199	236	283	289	210
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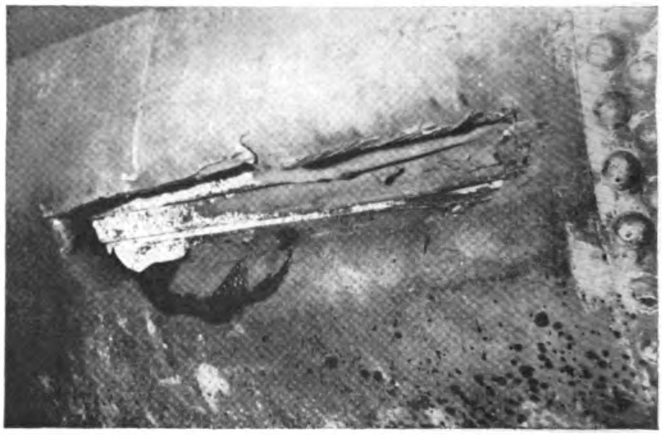

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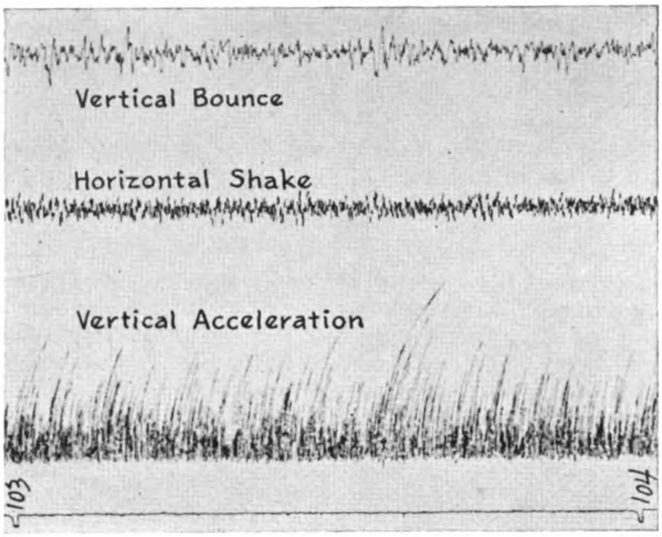
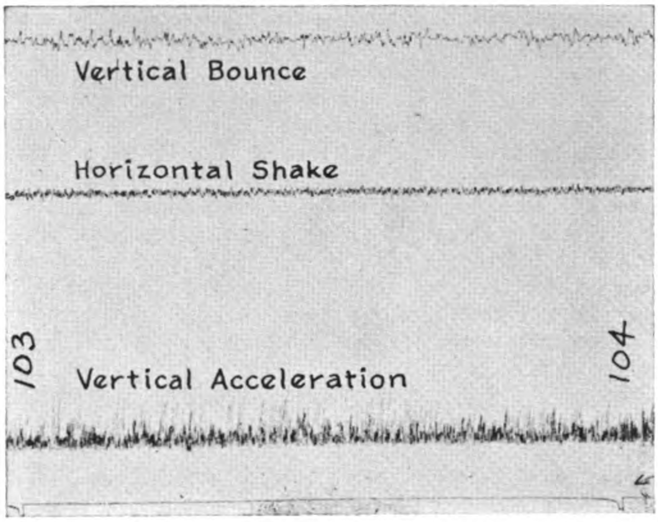


A-1 wedge type buffer—54.5 m. p. h., November 21, 1938



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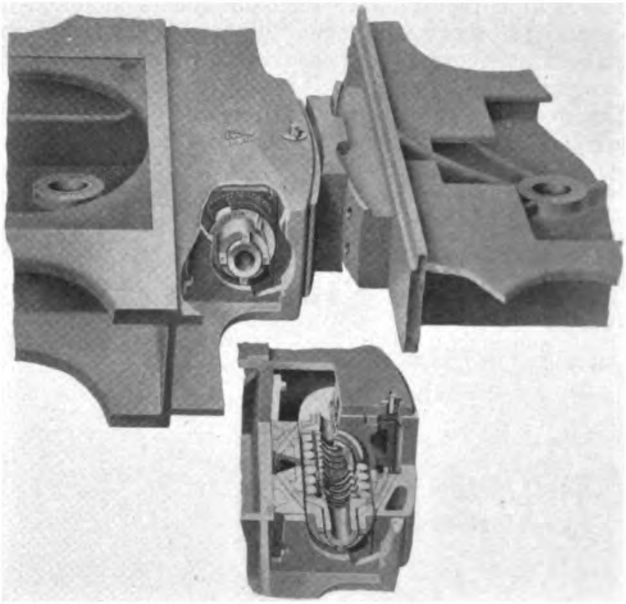


The E-2 type radial buffer

locomotives the E-2 radial buffer,* an automatic mechanism embodying two principles: first, the entire elimination of slack between engine and tender; second, the utilization of spring-actuated friction members which provide high resistance to the forces of compression between engine and tender. The utilization of these principles makes possible a design of buffer that enables the tender to become practically an integral part of the locomotive. The E-2 buffer still retains adequate provisions for radial action and disalignment caused by curving, turnouts, and track irregularities. Application of the improved design of buffer has resulted not only in greatly improved riding qualities of the locomotive, but has also brought about a very material reduction in maintenance costs that result from such factors as loose cabs, broken piping, displaced arch bricks, worn drawbars, drawbar pins and chafing plates.

Recently some comparative tests between the old and new type buffers were made in passenger service on a western railroad. These tests were made with a shock and vibration recorder. This type of instrument, illustrated in the photograph, is well recognized as an apparatus for securing accurate data in connection with the riding qualities of rolling stock. As a part of its development it was tested for accuracy on the shake tables at Purdue University. On the road tests this shock and recording instrument was secured to the deck of the locomotive below the engineer's seat box.

The comparative tests were made with the same locomotive, a 4-8-2 type with 74-in. driving wheels. The tests were conducted with the same number of passenger cars, over the same track, and on the same operating schedule. No work was done upon the locomotive between tests other than the change of buffers. Track conditions were exceptionally fine.

The first test was conducted with the locomotive equipped with the old-style wedge buffer which was in excellent working condition and properly adjusted. Two days later the comparative test was run with the E-2 buffer.

The chart contains reproductions of comparative and representative portions of the records made by the automatic recorder between mile posts 103 and 104. The upper half of the illustration shows the performance with the old-style buffer. The lower half shows the performance with the E-2 buffer and clearly indicates the benefits obtained. The speeds over this section of track were practically identical.

These comparative graphical records show the improvement that can be made in the riding qualities of a locomotive with the E-2 buffer, particularly in smoothing out or damping the effect of the unbalanced forces of the reciprocating masses.

The vertical displacement of the upper line, marked "Vertical Bounce," is equal to one-third of the actual vertical movement of the locomotive on the chart from the instrument.** With the old buffer a maximum vertical displacement of 0.45 in. is shown as compared with a maximum of 0.25 in. on the chart of the test with the new buffer. This is a reduction of 50 per cent in favor of the new buffer.

The vertical displacement of the second line on the chart ** measures approximately one-half of the actual fore-and-aft horizontal shake of the locomotive largely due to the unbalanced forces of the reciprocating masses and inherent factors of steam distribution. An average measurement of this line on the test with the old-type buffer is approximately 0.20 in. as compared with 0.06 in. with the new buffer, or a reduction of approximately 66 per cent. This indicates that the damping properties of the improved design of buffer have been very successful in absorbing or diminishing the horizontal shake so that it indicates less than one-third of that obtained with the old buffer.

The third line on the chart, labeled "Vertical Acceleration," has a definite relation to the upper line and is really an indication of the change of velocity during the vertical movement, or, in other words, the shock of the impact caused by the vertical movement. One-inch movement of the pencil ** represents an acceleration of one *G* (32.2 ft. per second per second). A comparison of the maximum deflection of this line shows 1.40 *G* with the old buffer and 0.53 *G* with the new buffer, a reduction of approximately 62 per cent. If it were pos-

The shock and vibration recorder with which the comparative records were made

* For a complete description of the E-2 buffer see the *Railway Mechanical Engineer* for April, 1934, page 110.

** The illustration in this article is two-thirds the full size of the charts taken from the instrument.

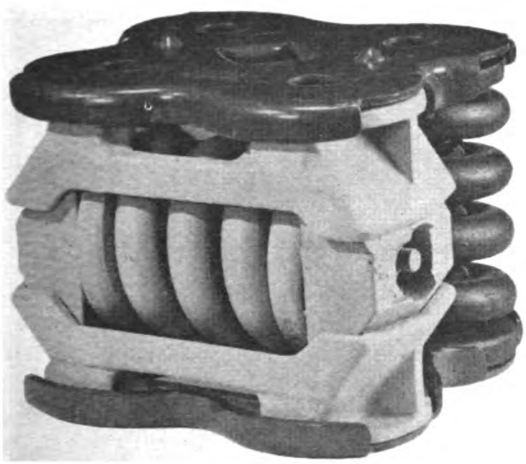
sible to determine an average of this line, it would probably be still less—only about one-fourth of the average obtained with the old buffer.

The best possible counterbalancing of a locomotive is highly essential for the best practical and economical results from a locomotive and track structure standpoint. But even when that is accomplished, the test data described herein indicate how a buffer making the tender, in effect, an integral part of the locomotive can absorb the effects of unbalanced forces and at the same time provide increased comfort for engine crews and train passengers and afford the means for greatly reduced maintenance costs.

In addition, the damping effect afforded by the new buffer suggests the possibility of still further reduction in the percentage of locomotive reciprocating weights balanced which, in turn, will decrease dynamic augment and the resulting track stresses.

Barber Freight-Car Snubber

The new Barber snubber illustrated has recently been developed by the Standard Car Truck Company, Chicago, especially for inclusion in the spring group of freight cars to promote easy riding, reduce lading damage claims occasioned by the vertical harmonic action of the springs, and reduce the general maintenance expense of cars. The unique features of this snubber are



Barber freight-car-truck snubber, notable for simple, rugged construction and large friction surfaces

that it displaces two springs of the group instead of one as is customary with the barrel-type snubber, and has large frictional area, producing low pressure per square inch of contact.

It is preferably applied lengthwise of the car, and when substituted for the two outside springs it is exposed for easy inspection. The illustration shows the snubber applied in the spring group in combination with a flanged type of spring plate.

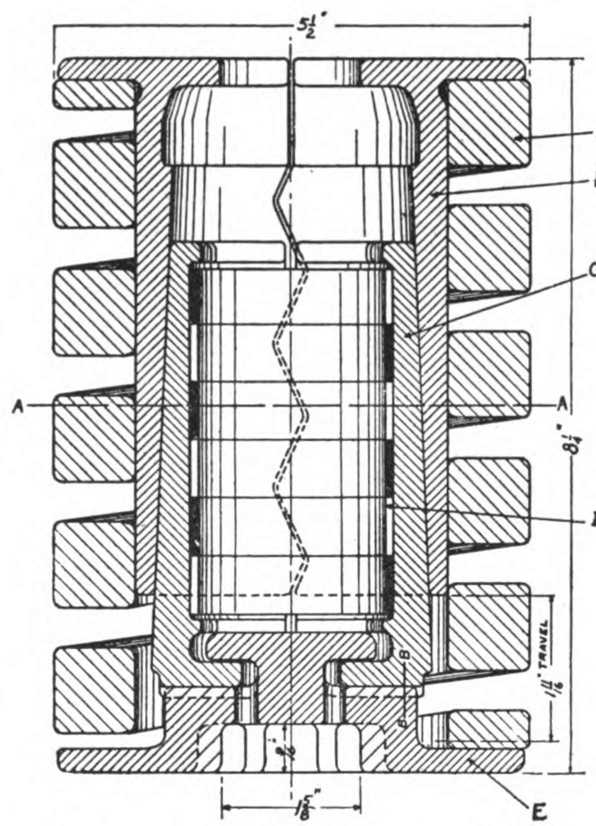
The upper and lower housings of this snubber are interchangeable as are also the friction castings. The housings are made of heat-treated alloy cast steel, and so designed as to fit into any standard type of plain or flanged spring plate for use with the conventional type of side frame for freight-car trucks. The friction castings are of special alloy friction iron which operate against a double-coil spring.

This snubber is simple in design, free of small pieces that usually show rapid wear, and is said to produce an exceptionally easy ride under all conditions of load. Because of the large area of frictional contact, the pressure per square inch exerted against the friction members is unusually low, thereby tending to assure long and satisfactory life.

Friction Bolster Spring

The Type-H friction bolster spring, recently developed by the Railway Truck Corporation, Chicago, Ill., is designed to protect equipment and lading from vertical shocks in modern high-speed freight-train operation, by utilizing the largest possible frictional surfaces in the space available and thus reducing to a minimum the unit working pressure.

The distribution of work in this unit, the construction of which is clearly shown in the illustrations, is spread over three surfaces as follows, expressed in terms of travel area: Surface between shoes and casing, 70 sq.



Cross-section of Type H railway-truck friction bolster spring

in. of travel area; surface between main spring and casing, 12.5 sq. in. of travel area; surface between inner springs and shoes, 3.25 sq. in. of travel area; total, 85.75 sq. in. of travel area.

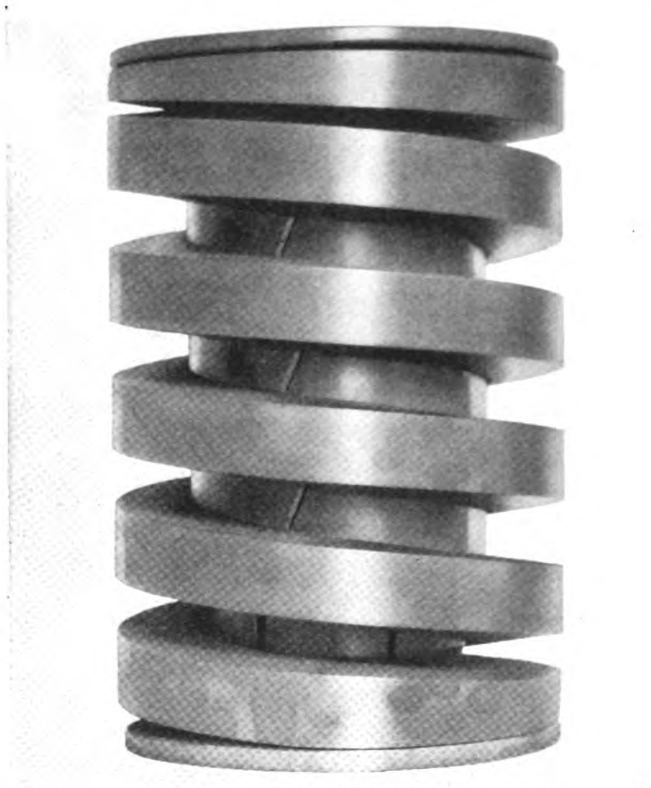
The surface between the shoes and casing develops 82 per cent of the work in the unit, the balance, or 18 per cent, being developed between the springs and their respective surfaces. The unit has reserve travel of 1/8 in. after the bolster springs go solid; the main spring *A* has a further reserve of another 1/8 in.

The inner split-ring springs *D* are placed under sufficient compression always to insure ample resistance to the inward movement of friction shoes and take up slack due to wear. When in service, the actual move-

ment of these inner springs is very small; consequently the tendency toward fatigue is negligible.

The casing *B* is made in three parts with its edge surfaces staggered to prevent ridges wearing on the surface of friction shoes. This casing is made of forged alloy material, heat treated to resist wear. The frictional shoes *C* are also forged. The base casting *E* is made of electric cast steel, electrically galvanized.

This device can be taken apart and re-assembled without the use of any tools or shop equipment, in a few minutes. A few end blows place the shoes in proper



Exterior view of the friction bolster spring

position so as to bring the free length of the unit to 8⅜ in. The device is designed so that it cannot be assembled incorrectly.

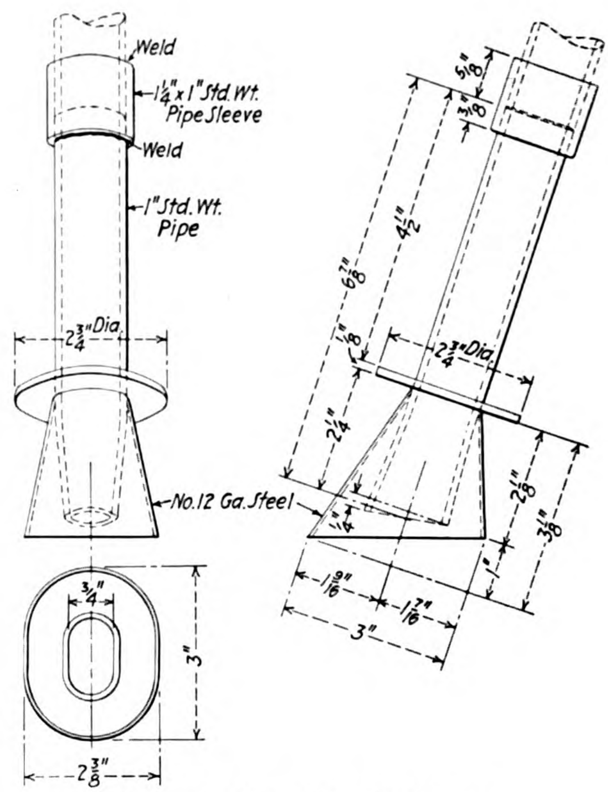
The Type-H friction bolster spring is said to eliminate approximately 80 per cent of the vibration of ordinary truck spring groups, which is the maximum absorption capacity ordinarily desired. One friction bolster spring inserted in each nest of truck springs, placed in diagonal corners of the bolster, is recommended practice. Where friction bolster springs have been applied, an appreciable increase has been noted in the life of bolster springs, and other car parts, as well as reduced damage to lading.

A New Locomotive Sander Pipe End

While it is customary to give great care and attention to supplying dry sand to locomotives at engine terminals, much of the benefit may be lost by the effect of moisture in congealing the sand at the lower discharge ends of the sander pipes. This condition is particularly aggravating in freezing weather.

To overcome this difficulty, the Soo Line has, for several years, been using a skirted sander pipe end originated by J. B. Swan, a locomotive engineman on this road. This sander pipe end is shown, as finally perfected, in the accompanying drawing.

The oval skirt surrounding the pipe end serves to catch the moisture which, in the wind, purls to the bottom, and is prevented from reaching the sand flow exit. The



Wilson double-skirted sander-pipe end

top skirt or washer is included in the design principally to serve the purpose of an anvil for members of engine crews to strike in conformity with habit when they assume that the pipe is blocked.

This device is manufactured and marketed by the Wilson Engineering Corporation, Chicago.

Cork and Rubber Molded Sound Insulation

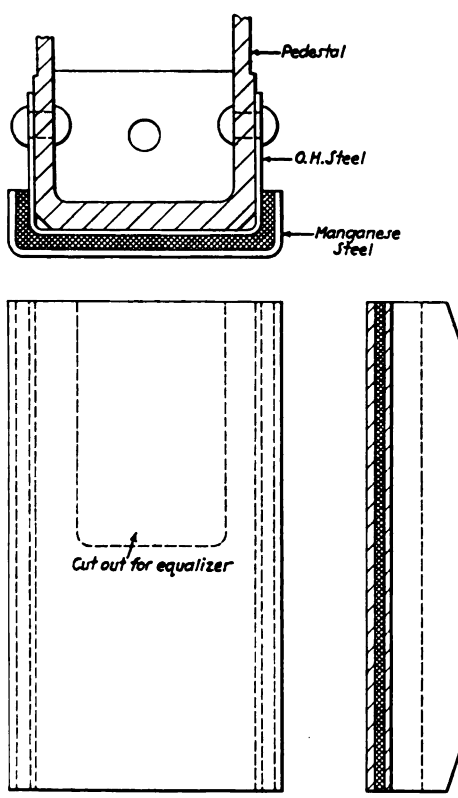
A means for preventing sound transmission from rail to truck and into the body of the railroad car by the use of cork and rubber, and cork and synthetic rubber compounds has recently been developed by the Armstrong Cork Company, Lancaster, Pa. The pedestal is isolated from the journal box and the helical springs from the equalizer bar and the truck frame by preformed pads of the insulating material.

One of the drawings shows a pedestal liner of the riveted type. The insulating material is molded between the back and the wearing face of the liner, to both of which it is vulcanized. The wearing face is preferably made of manganese steel, but sometimes made of spring steel. The thickness of the liner is held to very close tolerances.

Pedestal liners can be furnished in three types: the riveted type shown, the bolted type, and the tack-welded type. The face dimension or width overall of the liners

may be 8 in., 7¾ in. or 6⅜ in., as required. This dimension can be varied to meet the specifications. The length of the face may be from 18½ in. down to 14½ in. and can also be varied as needed. The outer liner is made with a solid face, and the inner or equalizer liner has the face cut out, as shown in dotted lines, to allow the equalizer bar to rest on the journal box. The width of the cut-out prevents metallic contact being made with the side of the liner or pedestal.

When lubrication is used on the pedestal, the composition or isolation material is made with a synthetic rubber base and cork. If the pedestal is not lubricated, a rubber and cork composition is used. The composition is bodily compressible to a degree that can be closely controlled. This property of controlled body compressibility, combined with controlled flow, makes this material peculiarly adaptable for this application. Rubber, on the other hand, under compression, must flow in some direction. This flow, or change of shape, causes a movement on the face and in the body of the material, and it is

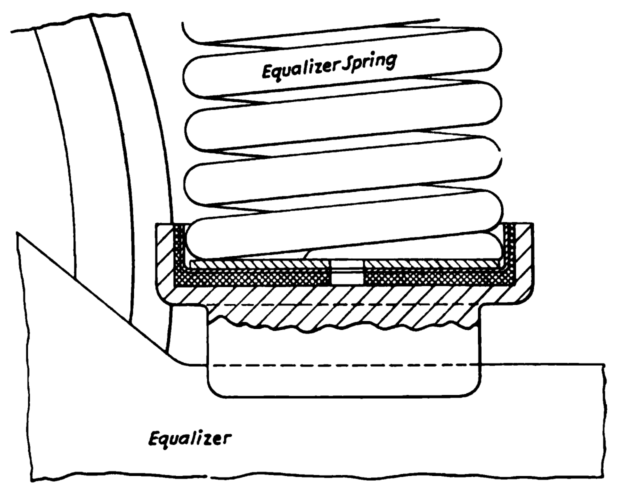


Sound-insulated pedestal liner

necessary to provide for this by placing holes, slots, or other means in the rubber, or in the confining metal. These holes, or slots, open the piece and permit lubricants and other materials to enter and attack the bond between the rubber and the metal. In addition, the tendency of rubber to flow tends to pull the stock away from the metal and destroy the vulcanized bond. In a compressible stock such as is used in these pads the flow is said to be in the direction of the applied force, which does not weaken the bond.

The use of the liners completely isolates the journal box from the pedestal and thus reduces the transfer of track noises and prevents their passing through the axle to the journal box into the body of the truck, except through the one remaining contact, which is the equalizer spring. Isolation of this spring is accomplished by the use of pads shown in the small drawing.

This isolation is obtained by means of the drawn steel cup into which the equalizer spring fits. This cup is reinforced at the bottom with a steel disc, which is electrically spot welded in place. The cup and disc have holes in the center to allow for drainage of water. The Armstrong cushion material is vulcanized to the bottom and outer edges of the cup flange in sufficient thickness to break the transmission of vibration and noise. The



Insulating pad for equalizer springs

pads are generally of ½-in. thickness at the base and standard sizes are made for 8-in. and 9-in. springs.

These pedestal liners and equalizer spring pads can be used on both four- and six-wheel trucks. By their use all metallic contact between the rail and the body of the car is broken.

General Overhaul of the New Haven Comet

(Continued from page 48)

plugged fuel-oil strainer in the No. 1 engine, was excellent in all respects. There were no hot bearings and the riding qualities of the train were considered to be equal to the original.

On the return to the shop, various odds and ends were finished up, seats and drapes were installed, and two days later the train was turned over to the operating department for return to Boston.

Conclusion

A general overhaul is one of the important occurrences in the life of a train like the Comet. The first one in particular inevitably brings to light conditions which definitely require correction, and the effectiveness of the remedies applied has a great bearing on the future of the train. In many instances the problems arising are entirely new, with little if any direct precedent for guidance. Likewise in any wholesale renewal of parts there is the question of changes in design of some of these parts. While very probably these changes are the result of progress and improvement, there is always the uncertainty of their success under special conditions. Hence, the real problem of a general overhaul is not alone the immediate one of return of the train to its original qualities of performance and comfort.

On the basis of the test results, it is believed that the general condition of The Comet is as good as, if not better than, it has ever been, and it is hoped that, barring minor troubles inherent in any major dismantling and re-assembly of equipment, this will be reflected in satisfactory service until the next general overhaul.

EDITORIALS

Dirt Behind The Ears

Air conditioning opened an era of cleanliness in passenger trains which immediately widened the range of possibilities for interior decoration. Pastel colors and drapes have been employed extensively in the interiors of the recently built deluxe high-speed passenger trains. The improvement in interior coach conditions, particularly with respect to the freedom from the infiltration of dust and fine cinders around the windows, is sufficiently popular so that a few years ago light colors for modern travel were advocated in ladies' apparel advertising.

Obviously, there must be a strong contrast in the appearance and attractiveness of the new, much-advertised deluxe trains and those which operate on secondary main-line schedules and on branch lines. If there were no contrast there would be no deluxe trains. There should, however, be a common basic standard of cleanliness for all passenger trains. Of course, cars without air conditioning and cars on local runs will not stay as clean as those which are air-conditioned and those operating on long non-stop runs. But the complete neglect, which is apparently the lot of most coaches on branch-line trains and many of those on secondary main-line trains, is evidence that too much of the psychology of the days when Pullman travelers were passengers and coach travelers were cattle still pervades the managements of American railroads. The coach passenger was not supposed to know how to treat anything in the nature of homelike furnishings. It was, in fact, assumed that he had no objection to traveling in filth, and the condition of many of the coaches in which he had to travel certainly did not suggest the idea that he need be careful in his treatment of the seats and floor of a coach, as he would be in his own home.

This attitude, no doubt, is the heritage of frontier days. Conditions, however, have changed. The frontier has been replaced with a type of material civilization peculiar to America, the emblem of which is the modern bathroom. There are few places in this country where the excuse that decent coach interiors will not be respected can be cited legitimately in justification of neglect of a decent standard of cleanliness or, indeed, for failure to provide attractive coach interiors. Dirty and vile-smelling branch-line coaches are a definite asset to bus lines and, in areas back from the main lines, are definitely creating an unfavorable public reaction which is canceling out some of the effectiveness and merchandising value of the advertised service on the main lines.

Recent attempts at restoring a favorable public reaction to local services, by redecorating and refurnishing the interiors of the coaches of important local trains, are a hopeful sign. Such efforts should continue to spread until the last railway coach on the continent has become at least as attractive as the bus with which it has to compete and then is maintained in a state of self-respecting cleanliness.

Economies of Light-Weight Freight Cars

At the November 21 meeting of the Western Railway Club at Chicago, K. F. Nystrom, mechanical assistant to vice-president, Chicago, Milwaukee, St. Paul & Pacific, discussed both the economics and engineering of lightweight freight cars, and reached the somewhat startling conclusion that 2,000,000 new freight cars should be built in the next ten years. Mr. Nystrom said, "The savings which would result in reducing weight on the scale previously given, namely, $60 per car per year, applied to the 2,000,000 cars to be built would amount to $12,000,000 annually for each year the quota of new cars are in service, and this saving will multiply as additional new cars are added each year, or a total saving in ten years of $660,000,000; allowing that conservative engineers would prefer to accept only 50 per cent, the possible saving still is enormous. To build 2,000,000 freight cars at a cost of say $2,000 each, would be a capital investment of four billion dollars which would go a long way toward restoring employment and prosperity."

Various estimates have been made regarding the possible savings as a result of reducing the tare weight of freight cars, one of the most commonly quoted being $18 per ton per year. Among those who contributed to the discussion following Mr. Nystrom's paper was G. S. Goodwin, mechanical engineer, Chicago, Rock Island & Pacific, who submitted the accompanying table giving a breakdown of weight savings and resultant increases in cost of various detail parts of a modern lightweight steel box car, and setting up an estimated net saving by reduced weight of $17.15 per car per year, which corresponds quite closely with the figure previously mentioned.

The concensus of the meeting was that while the new high-tensile low-alloy steels have not, in general, been in service long enough to demonstrate fully their corrosion-resistance properties, the indications are that their expected service life will probably be as much greater than that of copper-bearing steel as the latter is greater than carbon steel. Economies as the result of weight savings are also of great importance and will prove of benefit to all railroads in proportion to the speed with which the modern lightweight freight cars

are installed in actual service to replace the old heavy equipment.

Detailed Freight-Car Weight Savings and Costs-Economies

	Reduction in weight	Increase in price
Cor-ten and Man-ten in underframe and sides of car—includes castings	2,200	$65.36
Roof—(Estimated)	300	13.75
Murphy ends—(Estimated)	550	36.30
Side doors	410	19.18
Side door fixtures	184 Cr.	1.85
Coupler yokes	100	7.00
Couplers	200	12.00
Truck side frames	400	39.00
Truck bolsters	350	21.70
Total	4,694	$212.44

THE ECONOMICS OF LIGHT WEIGHT

Saving in deadweight, lb.	4,700
Miles per year on own line (30 miles per day for 200 days)	6000
Ton miles	14,200
*Cost to move one net ton freight from annual report at .0037 multiplied by ½ is	.00185
Saving account hauling less weight	$26.27
Increased ton miles due to heavier load for 600 miles (1/10 of total miles on line)	1410
Revenue at 1 cent per ton mile	$14.10
Total savings per year	$40.37
Interest on investment of $212.44	19%
Saving per ton reduced weight	$17.15

* This figure is produced by multiplying the cost of moving one net ton of revenue freight by the ratio of weight of average live load to total weight of car at rail.

Progress Continues in Locomotive Maintenance

The twenty-seventh annual report of the chief inspector of the Bureau of Locomotive Inspection to the Interstate Commerce Commission for the fiscal year ended June 30, 1938, which appears in abstract elsewhere in this issue, contains, in its statistics, a rather significant story of the progress that is being made by the railroads of this country in locomotive maintenance. Viewed from the standpoint of the number of locomotives found defective and the number of defects found by the inspectors of the bureau the year covered by the report was one of the most satisfactory of the past six years. Not since 1933 has the average number of defects per locomotive inspected been as low as it was last year. In 1933 there were 87,658 locomotives inspected, and 32,733 defects reported on the 8,388 locomotives that were found to be defective. In 1935 there were 94,151 locomotives inspected and 44,491 defects found on 11,071 locomotives. In 1938 the bureau's inspectors covered 105,186 locomotives and on 11,050 locomotives found to be defective there were 42,214 defects. During the last reported year the number of locomotives inspected reached the highest figure in recent years—5,153 more than during 1937—and, at the same time, there was a very substantial reduction in the number of defective locomotives and the number of defects found. The fact that 7,532 fewer defects were found than in 1937 is an encouraging indication that, even with the curtailment of expenditures for maintenance that had of necessity to be made as a result of reduced earnings, an increasingly high standard of maintenance had been set.

It would be natural to expect that the movement of heavier trains, in both passenger and freight service, at constantly increasing speeds would impose upon the many parts of a locomotive a burden that might result in a greater number of failures of such parts. There is a certain amount of satisfaction in knowing that the many improvements in the character of materials, the changes that have taken place in shop and enginehouse practice and the continued efforts of the mechanical-department personnel to improve an already good record for safe and efficient operation of motive power have borne fruit.

Aside from these facts there is also the factor of the cost of maintenance. For several years the more progressive mechanical officers have been preaching the value of preventive maintenance. The experience of most roads has proved this value. So, therefore, the records of federal inspection take on additional significance when it is realized that any substantial reduction in the number of defects found on locomotives is a certain indication that the factors which contribute to high repair costs and expensive road delays are being held in control.

The establishment of unusual records in any field of endeavor imposes upon us the necessity of greater effort in order to equal and surpass the existing records. What has been accomplished in the past six years has been under exceptionally unfavorable conditions. To improve in the future is going to require more than ordinary improvements in the facilities used in repair work. This is a factor that should be considered now while traffic is still below normal.

The Patent Problem

The Temporary National Economic Committee, familiarly spoken of in the newspapers as the monopoly investigating committee, devoted one of its early hearings to the patent question. Doubtless there may be certain features of our patent laws which, in the interests of fairness, should be revised. Anyone, however, who has had close contact with the railway mechanical department over several decades can recognize the necessity of affording protection to inventors.

Here, for instance, is a meritorious improvement which an ingenious inventor has developed after much study and experiment, usually on his own time and aside from his regular duties. Indeed, in many instances he is not even a railway employee. Eventually he may secure a patent for his device, but it is then only just started on its way. In most cases it is extremely difficult to find anyone who will try it out in practical service and then it may prove to be inadequate in some respects, or it may even fail abjectly, in spite of the fact that the idea may appeal to the practical railroaders who are conducting the test. More time and thought and expense must then be given to improving it, in order successfully to meet the requirements. In many instances the perfection of a device of this

kind has required several years of painstaking effort.

Even after the device has proved successful in service, however, it is a difficult task to get the railroads to use it, or to dispose of it to some person or company who can successfully merchandise it. If the inventor is not afforded reasonable protection he may stand to lose everything if, when the device has become serviceable, some shrewd person or company steps in and starts to manufacture and sell it; indeed some of them have enough trouble, as it is, to prevent chiseling.

Most inventors would not gamble on developing and perfecting a new invention unless they felt they had a reasonable chance of cashing in on it. Many of them might not do so anyway, if they realized the long and hard road that lay before them in perfecting and merchandising their inventions. Unfortunately, also, only a very small percentage of such people actually do profit to any considerable extent from their efforts.

Certainly society cannot afford to discourage invention. Kenneth H. Condit, assistant to the president of the National Industrial Conference Board, at a recent public forum under the direction of the American Engineering Council, in speaking on the social and industrial values of invention, pointed out that, "Our whole livelihood and standard of living is based on inventions. It may be that mechanical invention has outrun social invention, but so long as we can keep alive within us the spirit of invention our chances for survival as a nation are bright."

Harry H. Semmes, chairman of the patents committee of the American Bar Association, in speaking on economic aspects of the patent survey at the same forum, stressed the importance of inventions in another way. "America," he said, "has grown in the past largely by reason of the impetus given to the American life by three frontiers—first, the frontier of new land; second, the frontier of new people resulting from a rapidly increasing population; and, third, the frontier of new inventions creating new wants in mankind, and new industries to supply these wants. The first frontier of new land is gone. It has been estimated that the population will be stable by approximately 1950, and will shrink thereafter. We can no longer rely on the frontier of rising population. This leaves as the last frontier the frontier of research, new discoveries, new inventions, new industries. This frontier need never be closed."

Referring to the patent system, he said, "It is a good system. It has brought America far. If any real abuses are prevalent let them be aired, but let us make certain that these abuses constitute a real problem. Don't burn down the house to get the rats." Indeed, Mr. Semmes went so far as to indicate that it might be well to consider encouraging investment during the early stages of enterprise based on patents. He even suggested that "something might be done along the lines of remission of taxes for the first few years of a venture built on patents, or some other stimulus might be used to help the patent system expand the one remaining frontier: the frontier of human wants."

New Books

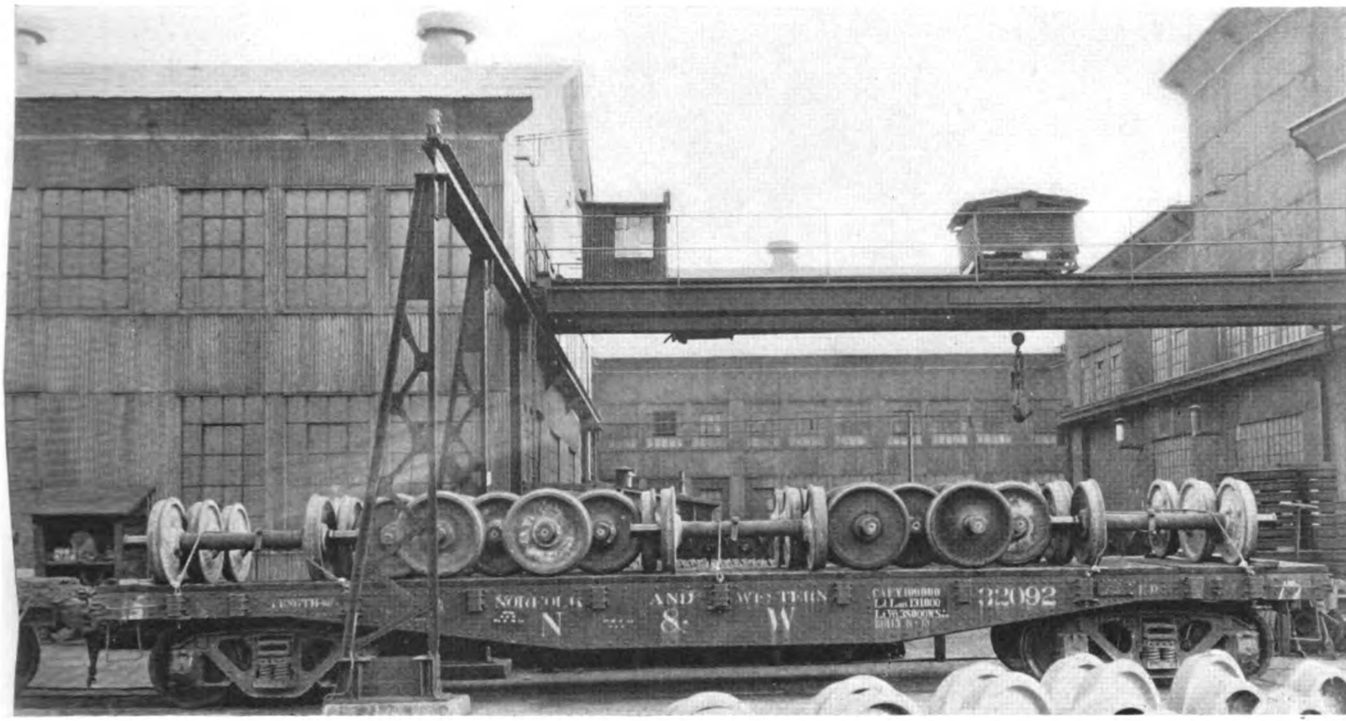
MANUAL OF ORDINANCES AND REQUIREMENTS IN THE INTEREST OF AIR POLLUTION, SMOKE ELIMINATION, FUEL COMBUSTION. *Published under the auspices of the Smoke Prevention Association, City Hall Square building, Chicago. Price, 50 cents.*

In addition to the prepared papers which were read before the thirty-second annual convention of the Smoke Prevention Association held at Nashville, Tenn., May 17-20, 1938, the manual contains a large amount of information pertaining to smoke prevention, methods of grading the density of smoke emission and dust fall, as well as the methods of analysis for oxides of sulphur, a digest of smoke ordinances of 80 cities and smoke districts and instructions for proper firing of various types of furnaces and fuels. Most of the data pertain to heating installations and stationary power plants. In the proceedings of the recent meeting of the association, however, are several papers bearing on railway smoke prevention. These are: Selection of Fuel for Use on Railroad Locomotives, by John C. Lewis, road foreman of engines, R. F. & P.; Elimination of Smoke by Proper Handling and Firing of Steam Locomotives, by J. P. Morris, mechanical superintendent, A. T. & S. F., and What the Locomotive Brick Arch Does Towards Smoke Prevention and Fuel Conservation, by Thomas F. Kilcoyne, American Arch Company.

PROCEEDINGS MASTER BOILER MAKERS' ASSOCIATION. *Albert F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Price, $3.*

The Official Proceedings of the 1938 Annual Business Meeting of the Master Boiler Makers' Association, held at the Hotel Sherman, Chicago, September 27, 1938, contains reports on seven topics: Topic No. 1—What means can or have been suggested to improve circulatory and other conditions in the locomotive boiler to eliminate leaky stays and cracked side sheets?; Topic No. 2—Honeycombing and slagging of flues and tubes, its cause and prevention; Topic No. 3—Which type of application of waist-bearer angles or tees gives the least trouble; Topic No. 4—Pitting and corrosion of locomotive boilers and tenders; Topic No. 5—Prevention of cinder cutting of flues and tubes, firebox sheets, steam pipes, etc.; Topic No. 6—What can be done to overcome the cracking of outside throat sheets?; Topic No. 7—In the application of flexible staybolts to boilers, which method gives the best results? (A) Screw the bolt up to a decided seat in the sleeve, cut to length and head over the bolt on the firebox end. (B) Screw the bolt up to a decided seat in the sleeve and then turn back one-quarter turn before cutting to length and heading bolt over on the firebox end. Topic No. 8 lists the subjects for 1939 discussion. The proceedings also contain a list of the members in attendance at the 1938 meeting, the Constitution and By-Laws of the association, and membership lists.

With the
Car Foremen and Inspectors



Wheel Work at the Roanoke Car Shops*

By G. F. McFadden †

On the Norfolk & Western the principal wheel repair work is done at the Roanoke, Va., and Portsmouth, Ohio, shops, for the eastern and western general divisions of the railroad, respectively. Each shop has facilities for stripping, mounting and boring wheels, turning and burnishing axles and turning wheels and tires for freight and passenger cars and for locomotive tenders.

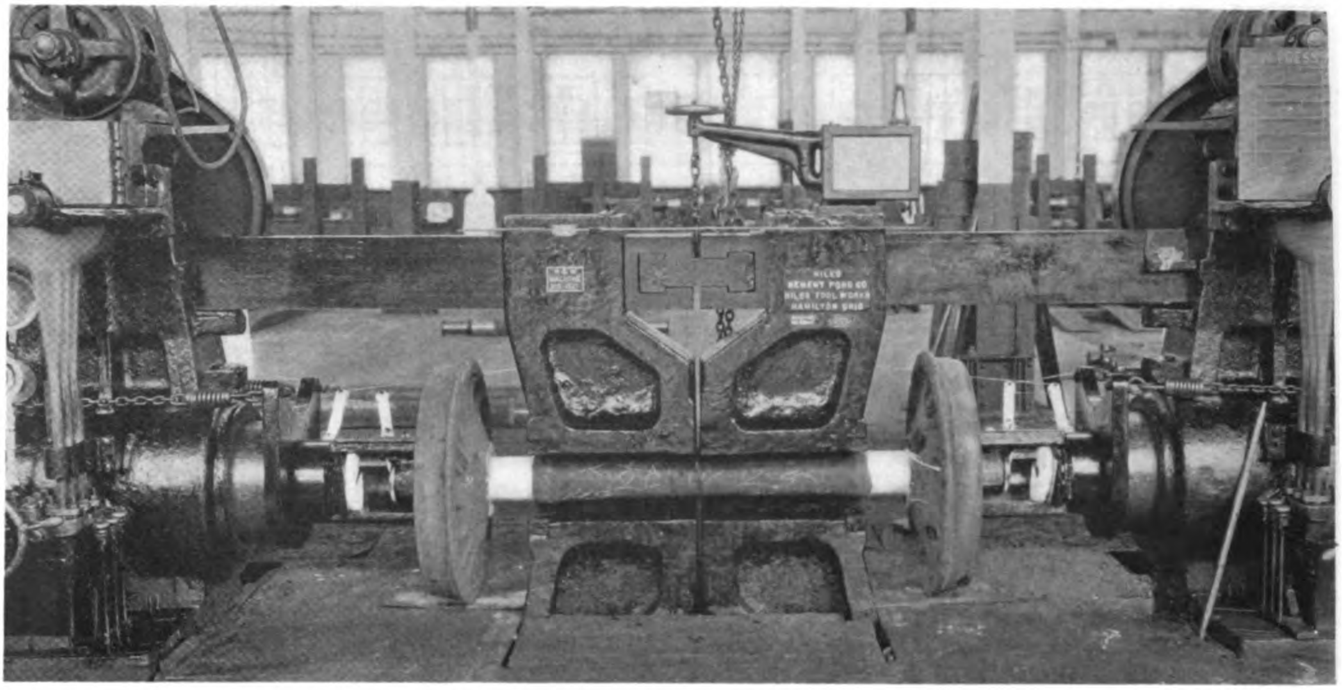
Wheels, which are shipped in to Roanoke from the various points are received on the service track (known as the loading and unloading track) and unloaded by means of an overhead crane, after which the wheels are inspected for defects. Under this overhead crane are tracks leading to the dismantling press and journal truing lathes. Each of the tracks is long enough to hold 30 pairs of wheels. The journal truing lathe also has an outgoing track as well as an incoming track to take care of wheels after they have been turned and burnished.

Multiple-wear wrought-steel wheels are handled to and from the wheel lathes through sliding doors back of the machines with ample space on the outside of the shop to take care of wheels that are to be turned, as well as those that have been turned.

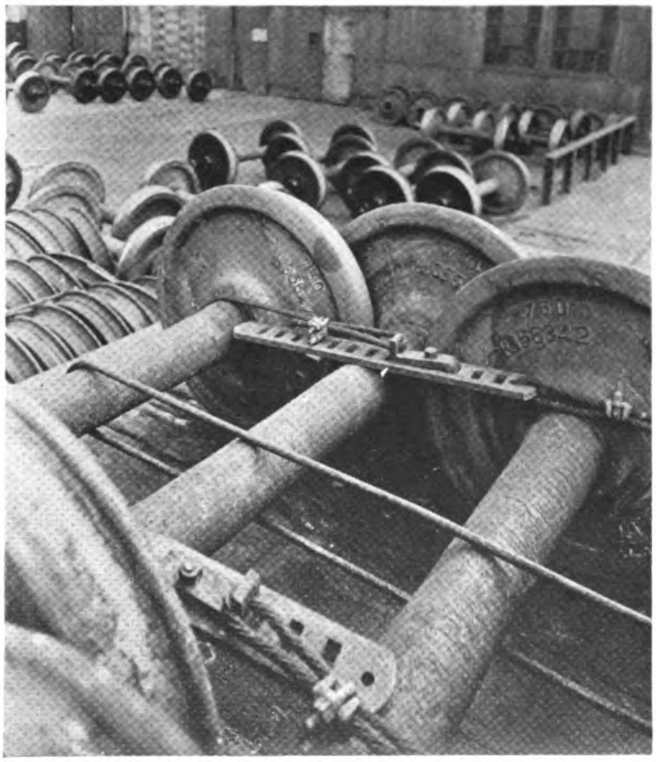
The axle lathes are installed parallel with the building with enough space for the operator to move freely between the machine and the building and with ample aisle space to handle the axles to and from the machines. Two sets of cradles in front of each axle lathe are for axles. One set is for the axle that is waiting to be machined, while the other set is to take care of the axle when it is finished and removed from the machine. The axle to be machined is placed in the lathe before the axle that has been finished is removed from the cradle to the axle rack. These cradles will prevent the axles from damaging the floor.

One of the illustrations shows the position of the car-wheel boring mills. In front of these machines is space to take care of wheels to be bored as well as wheels that have been bored. All of the boring mill chucks equalize and are equipped with hardened adjustable jaws and are operated by automatic control. In order to determine whether or not the boring mills are boring a wheel concentric to the tread, a tram plate is placed on the mill table on tram blocks of the same height. This tram plate is perfectly round and has a hole in the center concentric to the outside of the plate. The jaws are closed on this plate in the same manner in which a wheel should be chucked, an indicator is placed in the boring bar and while the machine is in motion, it will show the amount that the hole in the center of the tram plate is eccentric. After it has been determined which jaws are responsible for the hole in the center of the tram plate being eccentric, it is corrected by releasing the jaws from the tram plate and placing or removing shims behind the jaws on the chucks sufficient to shift the center of the plate in line with the boring bar. This is done with a quick-adjusting jaw and shims. If the jaws are worn, they

* Reprinted, in part, from the Norfolk & Western Magazine.
† Foreman, Wheel Shop, Roanoke, Va.



The hydraulic mounting press ready to apply a pair of wheels

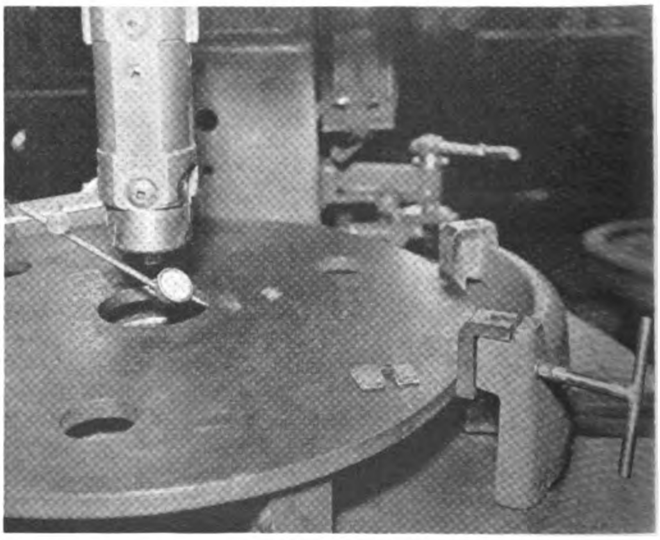


Wheel loading device, showing method of adjusting cables

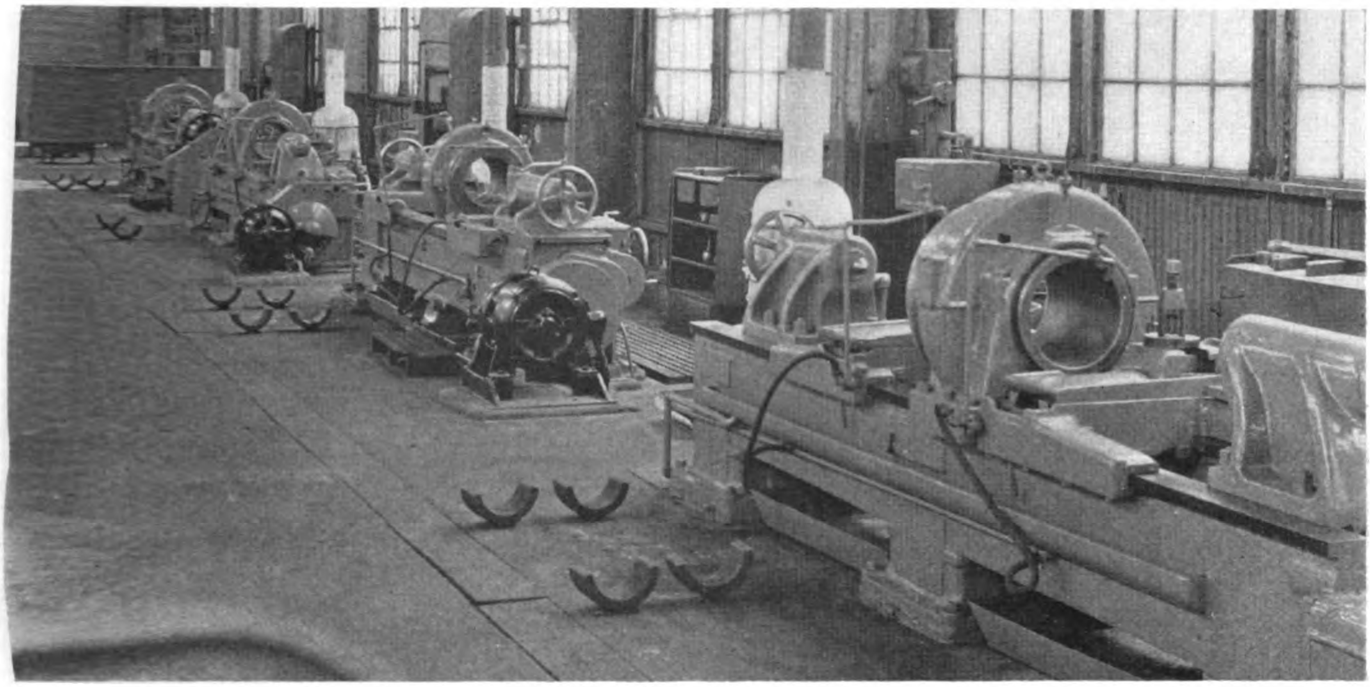
should be surface-ground on the top and face to the same thickness, the face having a 1-in-20 taper.

In addition to boring the wheel concentric with the tread, it is also important to have the top of the jaws the same height from the table. This condition is corrected by means of a holder in one of the tool spaces and grinding the top of the jaws off with a portable grinder while the table is in motion. This method of grinding will allow all the wheels to lay level, provided the flanges have the same thickness on the front side. To insure that the wheels are chucked level, a surface gage should be used on the back rim of the wheel.

The wheel-mounting press is equipped with recording devices. The latter operates automatically and simultaneously with the gage, furnishing a continuous recording chart and diagram of each pressure application. This recording device can be applied to either a single- or double-end wheel press, and when mounting wheels simultaneously, the recording gages will only record the pressure for the side to which it is attached. These recording attachments are accurate, durable and in every respect dependable, and can be adjusted quickly for different size wheels without removing the attachments from the shoes. A recorder and attachments increase production from the boring mills and mounting press as they keep the supervisor informed as to just how the wheels are being bored and mounted. If the chart shows more than the maximum pressure, the tolerance can be lowered, or, if it shows less than the minimum pressure, the tolerance can be raised. These attachments also show the condition of the wheel fits and how the



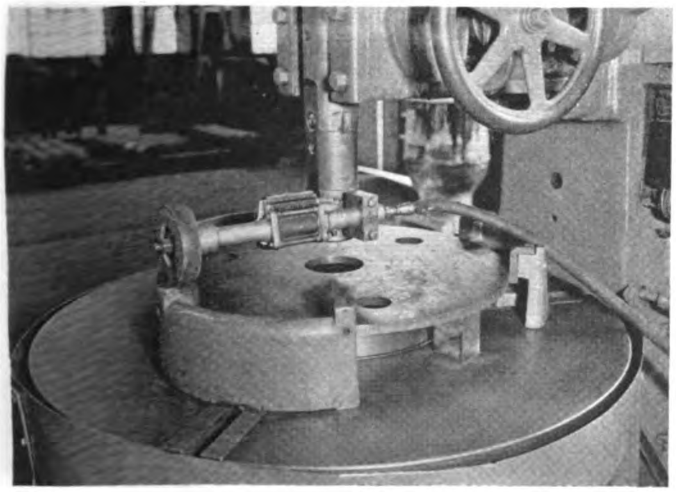
Indicator set-up for determining concentricity of wheel bores



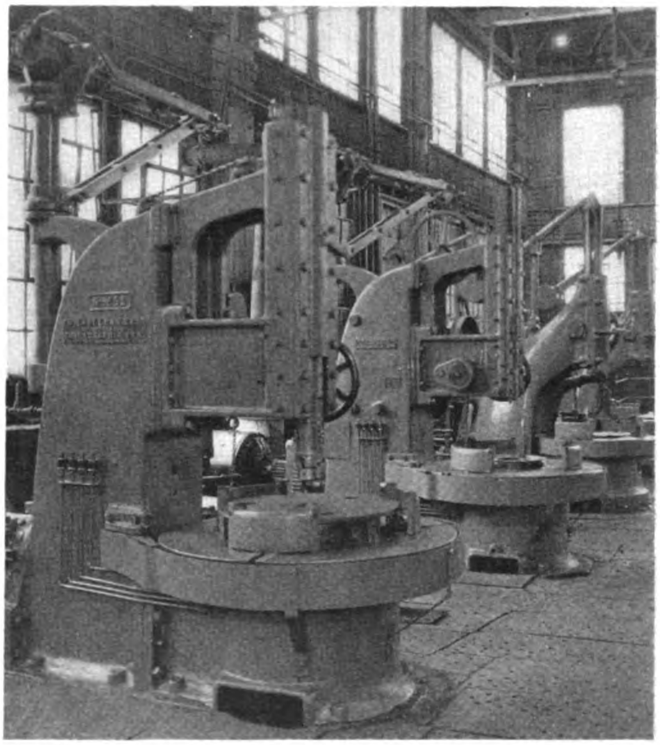
The axles lathe group—cradles for two axles in front of each lathe

wheel-press operator is lining up the wheels with the axle seat to prevent scoring. The recorder and attachments increase production since they keep the lathe and boring-mill operators in touch with their work while they are doing it.

The method, which originated and was recently adopted on the Norfolk & Western, for loading mounted car wheels and the quick adjusting device used for lengthening or shortening the cables to take care of different size wheels are shown in the illustrations. Scrap ¾-in. cable is used. This method of blocking wheels eliminates the use of wooden wedges and the wheels are secured to the car with much more rolling resistance than the old method of loading wheels crosswise on a car. There is not only a considerable saving in purchasing lumber for wooden wedges, but in using this method of loading wheels, the parts used for loading a carload of wheels from Roanoke to an outlying shop are later used at the outlying point to ship wheels back to Roanoke shops. The anchoring of these wheels is done entirely from the side pockets on the car.



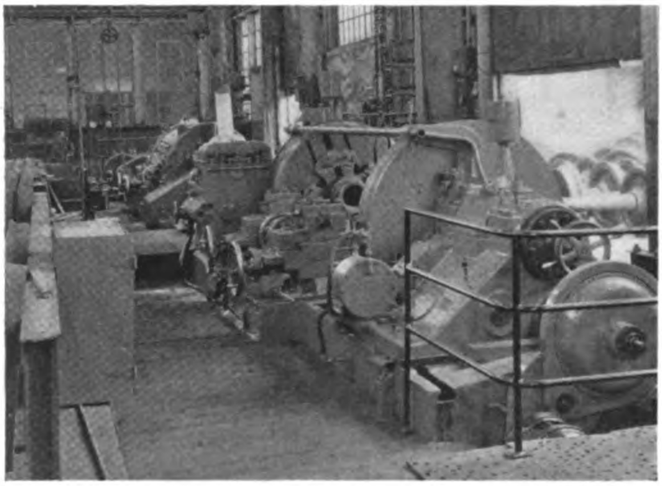
Tram plate jaws are ground with a portable grinder on the bar



A battery of wheel boring mills

The Roanoke wheel shop is equipped with three overhead cranes, one operating inside the shop and one at each end on the outside. The equipment also consists of two monorail electric hoists over the wheel presses, four axle lathes, two journal-truing gap lathes, two 42-in. car-wheel tire lathes, four car-wheel boring mills and two 600-ton wheel presses. Both presses can be fitted to strip or mount wheels.

All of the machines in this shop are so arranged that the wheels can be handled without congestion among the different machines, as all of the work is handled to and from the machines from the outside through sliding



The car wheel turning lathe

doors, using the outside instead of the inside of the shop for storage. In no case is it necessary for a pair of wheels to travel through the shop to get to the various machines.

Freight Car Dismantling Methods on the Rock Island

The Chicago, Rock Island & Pacific is carrying on a large junking program which is eliminating obsolete rolling stock and at the same time contributing substantially to the funds from which the new work is being financed. In two years the railroad has dismantled 5,800 freight cars and, with the moderate recovery of scrap prices, is now wrecking equipment at the rate of 200 freight cars and 15 locomotives a month—and incidentally getting a good price for old car bodies.

Dismantling Centralized

The dismantling plan has been to bring to Silvis, Ill., all condemned locomotives and all condemned cars in rolling condition. Chicago, 174 miles distant, is the railroad's best scrap market and Silvis is the location of the general store and main shops of the railroad where equipment can be dismantled and prepared for sale with the least rehandling and where recovered material can be prepared and redistributed most economically.

A schedule specifies the maximum expenditure permitted to put each class and series of equipment in condition for first class service at any one shopping. The figure is exclusive of wheels, couplers, trucks and body bolsters, draft gear and truck parts. Expenditures for running repairs are permitted up to 10 per cent of the standard maximum. The limit is $50 on some cars, $100 on other cars and $200 on still other cars, and $2,000 to $10,000 on locomotives. A uniform schedule

Car bodies stripped for truck mounting in the dismantling yard

of material prices, including shop and stores expense, is prescribed for estimating expenditures. Where the cost of repairs exceeds the allowable limit the cars are set aside for final inspection, following which they are properly labelled and placed in the rear of trains for

Diesel-engine-driven wheel press and air hoist used in dismounting and handling car wheels and axles

movement to the dismantling point. In this movement they are loaded with company material whenever practical. Equipment that cannot be moved is dismantled locally and the scrap shipped to Silvis for further handling.

Sell Car Bodies

The territory through which the railroad operates is largely agricultural and, from the outset of the dismantling program, box car bodies in reasonably good repair have been in demand, especially by farmers for use in building barns and even houses, and also for storing grain until the prices return to a parity with the prices guaranteed by the government to farmers who subscribed to the government crop control scheme or until the government takes the corn in payment of the loans. In the case of corn, these loans amount to 50 cents or more per bushel which is more than $150 more per car load than the farmers can sell it for at present prices. To meet this demand, the railroad has been selling the car bodies at prices ranging from $25 to $50 each and disposed of 770 car bodies in this manner in 1938. This year the sales at Silvis are made to contractors who truck the ready-made building over the highway for distances up to 100 miles.

All condemned box cars reaching Silvis with salable bodies are set on tracks in the car repair yard which are accessible from the highway. Car repairers, equipped with portable acetylene outfits, cut the bodies loose from the underframes and strip off grab irons, brake staffs and other fastenings. The drivers and helpers of several

Two car bodies ready for movement over the highways on special truck equipment

trucks then help each other remove the bodies. They raise the bodies off the trucks one at a time, push the underframe in the clear and place trailer wheels in position under one end of the car body. A truck is then backed crosswise under the other end, and the body pulled into the clear, whereupon the truck, equipped with a swivel center plate, is swung into position in front of the car body and made fast to the tongue of the trailer wheels, and the car body is ready for the road. At outlying points, the metal on the bodies is detached and loaded by the purchasers, who are usually farmers.

Special Yard for Cars

In addition to these cars, other cars are set aside and the inside sheathing removed for further use by the railroad. All other box cars received at Silvis and all cars from which the bodies have been removed at Silvis, are switched into the car-dismantling yard where the wood bodies are burned and the underframes and trucks are reduced to scrap and salvage.

This yard was previously laid out for storing coal. While approximately one-half mile distant by rail from the system's scrap-handling facilities and material storage yards, it is free from fire hazards and has four spur tracks, each approximately 1,000 ft. long, which are ar-

The crane in the car dismantling yard operates a 42-in. magnet

ranged in pairs so that alternate tracks can be used for loading. The yard has approximately 2,000 ft. of underground oxygen and acetylene lines which are connected with an overhead extension from the Air-Reduction-equipped central distributing plant near the shops. This reduces both the expense of gas and the handling of gas cylinders. The yard has a steam locomotive crane of 25 tons capacity, operating a 40-ft. boom and a 42-in. magnet, also a press for dismounting wheels and two air hoists for handling wheels.

The yard is operated jointly by mechanical and store forces. The mechanical forces, in keeping with shop craft agreements, perform all dismantling, which includes setting off the car bodies and removing couplers, brake beams, brake cylinders, brake masts, grab irons, etc. Store-department forces prepare the scrap for sale and recover any reclaimable materials.

From 10 to 20 cars are demolished at one time. Cars with wood bodies are usually set off on the burning track

Cost of Car Dismantling in 1937

Labor for dismantling	$12,333.79
Handling good material	3,072.56
Cutting scrap	16,161.45
Miscellaneous labor	1,388.20
Supervision, local	3,114.67
Loading scrap	6,185.55
Oxygen and acetylene	15,377.48
Tools and lubricants	928.33
Running repairs to cranes, etc.	454.88
Fuel, light, heat, power, air, water	2.118.57
Switching charges	2,075.31
Total	$63,210.79
Weight	44,217 tons
Cost per ton	1.429

in the afternoon and the bodies are burned at night so that the metal will cool by the next morning. Most of the scrap is reduced to heavy melting steel, which reduces to a minimum the amount of sorting required in handling. During the cutting operation the metal from bodies, frames and trucks, with the exception of wheels,

is practically all left by the men where it falls. The crane operator has the run of one track in each pair and when not engaged in setting off cars for burning, alternately picks up each grade of material and loads it into cars. With the magnet it is possible to segregate the scrap and to salvage from the scrap with little assistance from ground men.

Cars loaded with scrap are weighed out for direct shipment on sale orders. Good wheels on axles are loaded for direct shipment to outside points while scrap wheels on axles are run to the end of one of the tracks where the wheels are removed in a press driven by a gasoline engine and are then loaded by an air hoist. Where cars are dismantled at outside points, the scrap is moved to Silvis where it is sorted and prepared for sale in the general scrap dock under three 10-ton Gantry cranes.

Referring to one of the illustrations, the general arrangement of the wheel press and air hoist mentioned as being used in handling car wheels, is illustrated. The press is of the single-acting type, being located at a convenient place in the yard where mounted car wheels can be readily rolled to the press for the removing of the wheels. The press is belt-driven from a Fairbanks Morse 10-hp. type-Y semi-Diesel engine. The air hoist and light truss-type boom are mounted on a derrick base supported on wheels which permit limited cross travel on rails. Operation of the air hoist, cable and crane hook permits raising and lowering car wheels as required in dismounting and moving them out of the way of the press. The air hoist is swiveled by hand pressure on a long pipe handle shown in front of the operator, whose hand is on the air valve used in operating the hoist. This hoist has proved to be a great labor saver in loading car wheels and axles in cars for final disposition.

Questions and Answers On the AB Brake

Brake Cylinders (Continued)

365—*Q.—What will cause a blow at the brake-cylinder exhaust port in the service lap position?* A.—Leakage past the release insuring valve, the service slide valve or the service portion cover gasket.

366—*Q.—What will cause a blow at the emergency portion exhaust in the service lap position?* A.—Leakage past the vent valve, the emergency graduating valve, the emergency slide valve or the emergency portion cover gasket.

367—*Q.—What will cause a blow at the quick-service exhaust in the emergency position?* A.—A leaking graduating valve, a service slide valve, or a service portion cover gasket.

368—*Q.—What will cause a blow at the brake-cylinder exhaust in emergency position?* A.—Leakage past the service slide valve, release insuring valve, or service portion gasket.

369—*Q.—What will cause a blow at the emergency portion exhaust in emergency position?* A.—Leakage past the emergency slide valve, emergency portion cover gasket, timing valve diaphragm, accelerated emergency release piston seal, spill over check valve, or emergency portion slide valve strut diaphragm.

370—*Q.—Can the brakes be released with a train of AB equipment immediately after an emergency application?* A.—No.

371—*Q.—How much time should be allowed?* A.—Approximately 2 min.

372—*Q.—In the event of a brake stuck or overcharged how would you effect a release?* A.—Move the release rod part way, in order to reduce the auxiliary reservoir pressure.

373—*Q.—In case of a defective brake, how would you operate the release rod?* A.—Move the rod a full stroke in order to bleed the auxiliary and emergency reservoirs.

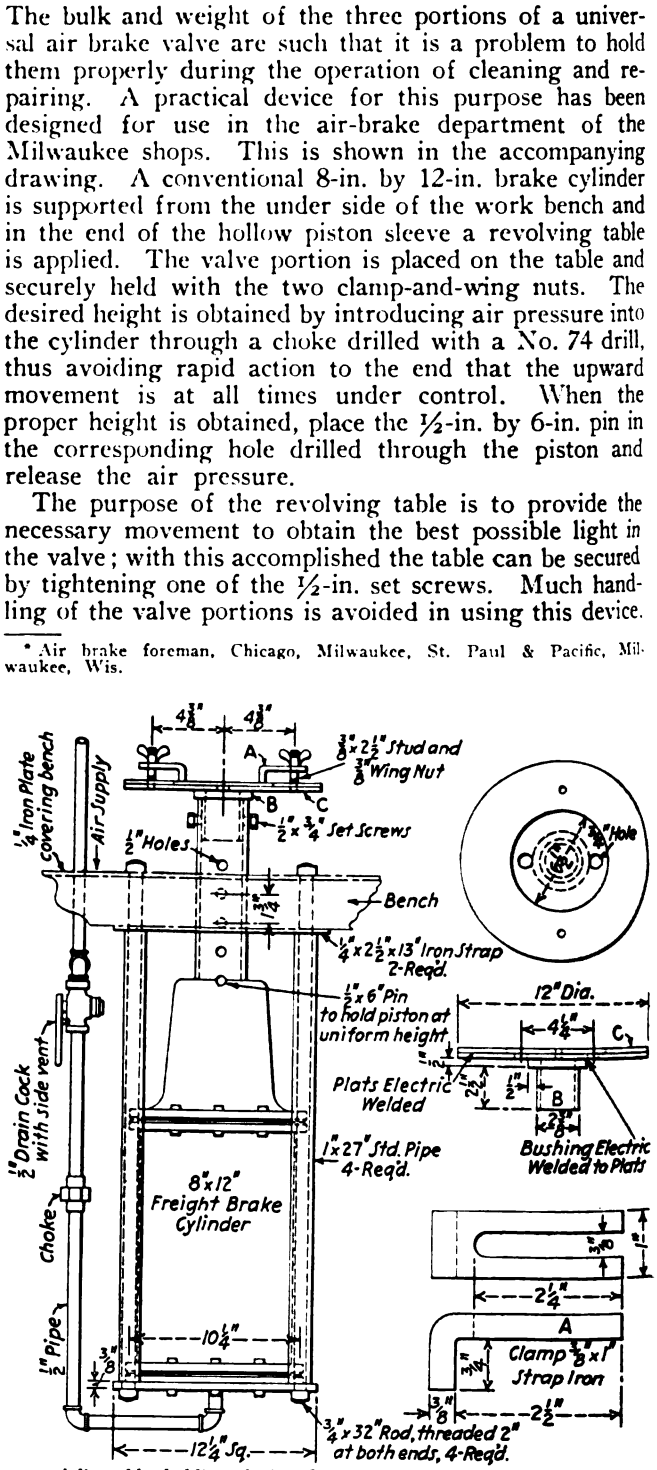
Device for Holding Universal Valves

By T. H. Birch*

The bulk and weight of the three portions of a universal air brake valve are such that it is a problem to hold them properly during the operation of cleaning and repairing. A practical device for this purpose has been designed for use in the air-brake department of the Milwaukee shops. This is shown in the accompanying drawing. A conventional 8-in. by 12-in. brake cylinder is supported from the under side of the work bench and in the end of the hollow piston sleeve a revolving table is applied. The valve portion is placed on the table and securely held with the two clamp-and-wing nuts. The desired height is obtained by introducing air pressure into the cylinder through a choke drilled with a No. 74 drill, thus avoiding rapid action to the end that the upward movement is at all times under control. When the proper height is obtained, place the ½-in. by 6-in. pin in the corresponding hole drilled through the piston and release the air pressure.

The purpose of the revolving table is to provide the necessary movement to obtain the best possible light in the valve; with this accomplished the table can be secured by tightening one of the ½-in. set screws. Much handling of the valve portions is avoided in using this device.

* Air brake foreman, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.



Adjustable holding device for universal valves used at the Milwaukee shops

Railroad Applications of The Metal-Spray Process

During the past year an effort was made to ascertain the extent to which metal spraying is applicable to repair problems in railroad shops. It has been a known fact for years that metal can be sprayed on various surfaces and has been extensively used in many industries for building up worn surfaces as well as for applying metal to others subject to corrosion. Although a number of railroads have made some use of the metal-spray process, some have discontinued its use while one or two others have been unusually successful with it. One railroad in particular uses this process successfully, and has found that there is a definite field wherein certain mechanical problems can be most satisfactorily solved with metal spraying. The following outlines the operations necessary for standard proved applications which have been found both successful and economical.

The Metal-Spray Process

A lightweight portable metal-spray gun, which may be fixed in any position is employed. As shown in Fig. 1, metal wire, oxygen, acetylene and compressed air are supplied to the nozzle tip of the gun. A compressed-air turbine propels a series of speed-reducing gears which feed the metal wire at uniform speed into and through the nozzle. At the tip of this nozzle an oxyacetylene flame melts the metal wire and compressed air atomizes the molten metal, blowing the resultant metal spray upon a surface which has been properly processed beforehand by cleaning and roughening. The metal can be sprayed until the built-up surface reaches any desired thickness.

The proper preparation of the base metal results in a foundation that enables the sprayed deposition to "key" itself to the parent body; therefore, the adherence is due to its "mechanical bond." To obtain this bond, flat surfaces are blasted with angular steel grit, sharp Cape May sand, or Joplin grit, since sharp cutting edges must be employed. When blasting, the blast nozzle is held at different angles to the surface to develop undercut caves and overhanging crags, which act as keys and anchorage for the new built-up slab of metal. Due to the high air pressure used in blast cleaning, both sand and steel grit penetrate into every crevice, and deeply score most surfaces; therefore, areas not intended to be metal sprayed are shielded with a rubber adhesive tape or cloth similar to that used by stone cutters. Shafts are shielded with friction tape.

A second method, threading, is also used for preparing surfaces for metal spraying. This method consists of threading the part to be metal sprayed and then removing the top of the threads with a flat-nosed tool.

When building up surfaces, it is almost always necessary to undercut the surface to be built up, both in order to have the correct thickness of sprayed metal on the finished job and in order to dovetail or key the ends of the coating. The amount which the work should be undercut is determined by (1) the size of the shaft and (2) the amount of wear to which it is to be subjected in service.

When surfaces have been prepared for metal spraying they must be kept clean from grease or dirt, and should not be handled with the hands. When necessary to handle, clean white cotton gloves should be used. Not more than eight hours should be allowed to elapse between the blasting operation and the metal-spraying operation in clear weather, and not more than two hours in damp weather; otherwise, oxidation will partially

Locomotive Parts Which Are Being Metal Sprayed Successfully

Duplex stoker elevator bushing.
Alco reverse-gear valve stem.
Precision reverse-gear screw, sleeve, shaft and trunk.
Locomotive piston rod.
Air-compressor-governor valve stem.
8½-in. air-compressor piston rod.
Worthington feedwater-heater bucket spindle and piston-rod tubing.
Elesco feedwater-pump piston rod.
Elesco exhaust steam injector water valve, piston stem, main steam nozzle, and overflow plates.

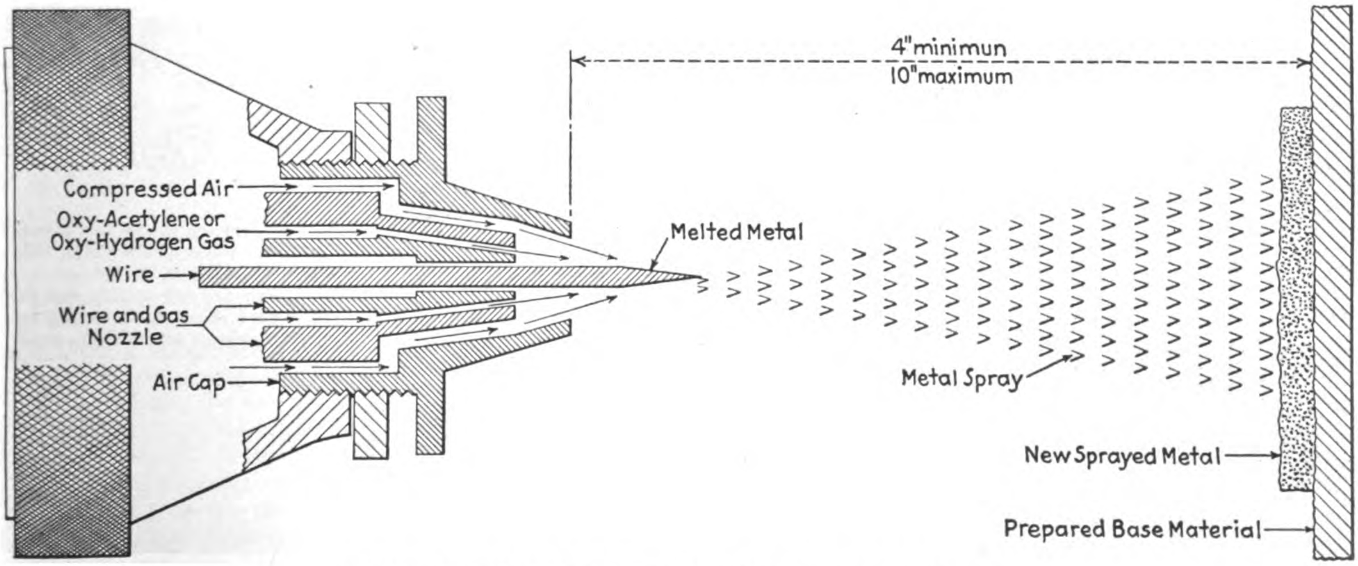


Fig. 1—Cross-section of the wire nozzle and air gap of a metal-spray gun

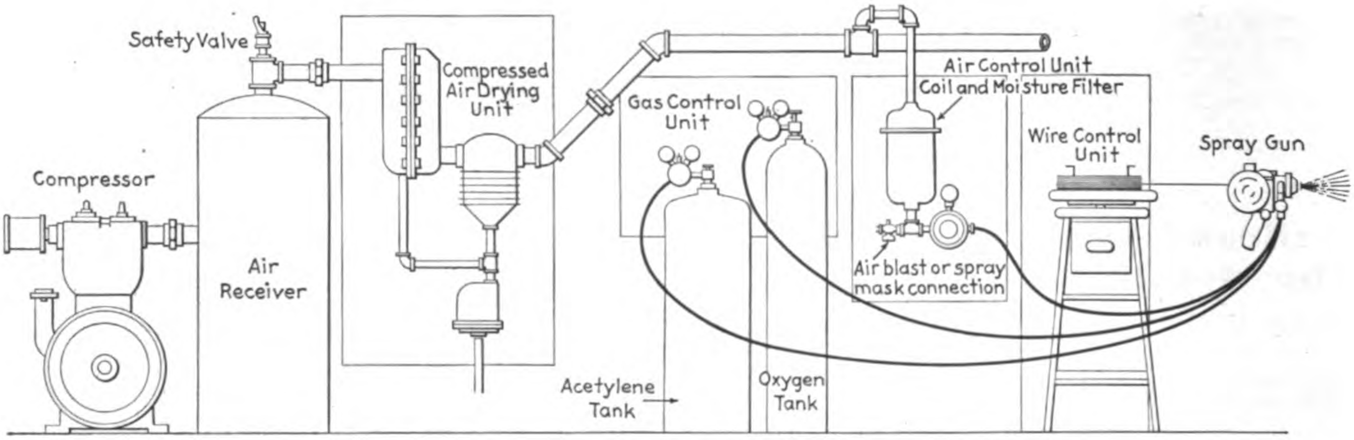


Fig. 2—Layout of equipment essential for successful metal spraying

destroy the ability of the new metal to bind to the base. Blasting is never conducted outside in damp or wet weather.

Fig. 2 shows the equipment necessary for the proper operation of the process. All of the parts shown are absolutely essential for successful metal spraying, and most failures can be attributed to lack of understanding of the various units involved. As will be noted, much of the equipment furnishes clean, dry, compressed air free from moisture and oil, which is a prime necessity. Wherever the climate or shop conditions are such that the air is damp or hot, condensed water in the compressed air supply will be an unending source of trouble unless it is eliminated. Likewise, worn compressors will pump an excessive amount of oil into the compressed-air line which must be removed before it reaches the gun. Such oil, as well as excessive moisture, is removed by a filter, which is part of the air-control unit shown in Fig. 2. The filter should be removed periodically, the length of use depending upon operating conditions.

The structure of sprayed metal is quite different from that found in cast, rolled or drawn metals. As the small molten particles are sprayed from the gun they strike the surface, where they flatten out, and cool almost instantly. Thus, a stratified metal structure of small flattened, interlocking, metal particles is built up, which is partly pervious due to the presence of slight amounts of oxide and absorbed gases.

This peculiar structure results in a change of physical characteristics of the metal. The ductility, elongation and tensile strength of sprayed metal are greatly reduced, when compared with the same metal in the cast form. On the other hand, the qualities of compression, wear resistance, corrosion resistance, hardness, heat and electrical conductivity remain virtually unchanged in so far as the practical uses of the process are concerned.

The metallizing process should not be used on applications where the sprayed metal will be subjected to sharp impact, continued pounding at one point, or severe edge strain. The process is, however, entirely satisfactory for use on surfaces where there is full-bearing contact rather than point contact.

Application of Metal Spraying in the Railroad Shop

The table shows various locomotive parts which are being metal sprayed successfully by a midwestern railroad. In addition, the metal-spray equipment located in the locomotive shop is used for metallizing miscellaneous passenger-car parts as well as parts of shop machinery. These include the following: drill-press spindle shafts; hydraulic-pump plungers; washout-pump piston rods; gear fits on all types of machine drive shafts; piston and valve rods for air compressors; rotor slip rings on shop-machinery motors; motor armature shafts and bearings; shafts and bearings of centrifugal pumps; fan-engine pis-

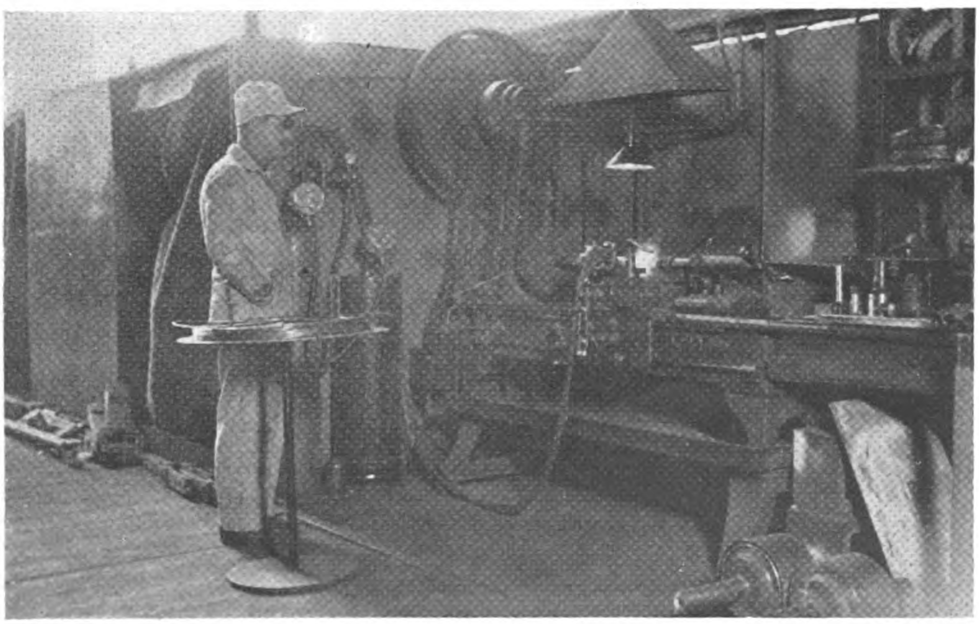


Fig. 3—Spraying tubing for Worthington feedwater-pump piston rods, which is reclaimed at 10 per cent of its original cost.—Note the exhaust hood above the lathe and the blasting cabinet behind the operator

ton rods; emery belt roller for flue polishers, and engine-lathe headstock drive spindles.

These parts represent but a few of the possible applications; however, these are mentioned because they have all been metal sprayed successfully and have been in service long enough to prove that the built-up surface gives a service life equivalent to, if not longer than, a new part or an old part built-up by welding.

In passing, it is of interest to note that the locomotive shop in question has on many occasions used its metal-spray equipment for metallizing parts sent to the shop by industrial concerns located in the same city. As a direct result of such work, seven of the city's largest industries have purchased and installed their own metallizing equipment as an aid to solving their shop maintenance problems.

All of the work here mentioned was done on the lathe and with accessory equipment shown in Fig. 3. There are three major operations involved in metallizing any of the parts: (1) Preparation of the surface to be metallized, (2) metal spraying, and (3) finishing.

The preparation of the surface to be metallized depends on the service to which the part in question is to be subjected. It may be set up in the lathe, undercut, dovetailed at the ends, and finally cleaned and roughened by blasting or rough turning. The size of the undercut depends on the extent to which the part has worn. Every part will wear a certain amount before it is either replaced or restored to size; this is termed "wear expectation." Regardless of what this wear may be, an additional under-thickness of sprayed metal must be added which is called the "minimum coat thickness" or "foundation." As a general rule, this foundation is 0.01 in. on the radius for a shaft 1 in. or less in diameter, and 0.005 in. of sprayed metal is added for each additional inch of diameter until a thickness of 0.04 in. foundation is reached. The wear allowance or wear expectation, the amount of metal which must be added to the minimum coat thickness to take care of the wear expected from service, is determined for each individual job and may vary from 0.001 in. to 0.250 in.

Whether or not the piece has been undercut, it is blasted or rough turned as described previously, with the various portions not to be metallized being protected by cloth or friction tape.

As shown in Fig. 3, the metal-spray gun is mounted on the tool post of the lathe and, after the flame and speed of the wire feed has been adjusted, the spray is directed on the work and the feed of the lathe carriage is locked. The speed of the work may vary up to 40 peripheral ft. per min., and the feed of the carriage is adjusted to a speed slow enough to provide a uniform application of the metal. The part should be sprayed evenly from right to left, or vice versa. The tip of the nozzle may be kept at a minimum of 4 in. or a maximum of 10 in. from the work. The speed and feed, as well as the distance of the nozzle tip from the work, varies for any given job. However, the exact value of these variables are not difficult to ascertain and considerable latitude in their adjustment is permissible with little effect on the finished product.

During spraying, the part should not be allowed to develop a temperature much greater than 250 deg. F., which is determinable by placing the back of the hand lightly against the work. If excessive temperatures develop, the part should be allowed to cool. Excessive heat may cause the metal to expand and pull away from the base, particularly when steels are being sprayed.

Finishing of the part may be either by wet grinding or machining. Grinding gives a better surface, and for the parts metallized in the shop in question grinding has been utilized almost exclusively.

Obviously, in this article only the fundamental features of metal spraying have been discussed. One fact cannot be overstressed; that is, the art of metal spraying requires extreme accuracy and care if it is to be successful. Also, no one should take it for granted that metal spraying is a simple process; it is a highly developed technique requiring much experience. Successful applications come only with a thorough knowledge of types of metal to use, the correct wire sizes, wire speeds, extension of the wire beyond the air gap in the nozzle, the correct air-gap setting, the pressures of oxygen, acetylene and air, the speed of the work in the lathe, the feed of the lathe carriage and the distance of the nozzle tip from the work.

After several years' experience, the shop wherein the work described in this article is being done has found that metal spraying can be successfully accomplished with gratifying economical results. For example, stoker elevator-shaft bushings are being reclaimed at 3 per cent of their original cost; main steam nozzles for Elesco exhaust-steam injectors are being reclaimed at 9 per cent of their original cost; overflow pistons for Elesco exhaust-steam injectors are being reclaimed at 20 per cent of their original cost, and tubing for Worthington feed-water-pump piston rods is being reclaimed at 10 per cent of its original cost. These parts, as well as many of the others previously mentioned, have given service equivalent to that of new parts, thus proving the adequacy of the mechanical bond effected by metallizing.

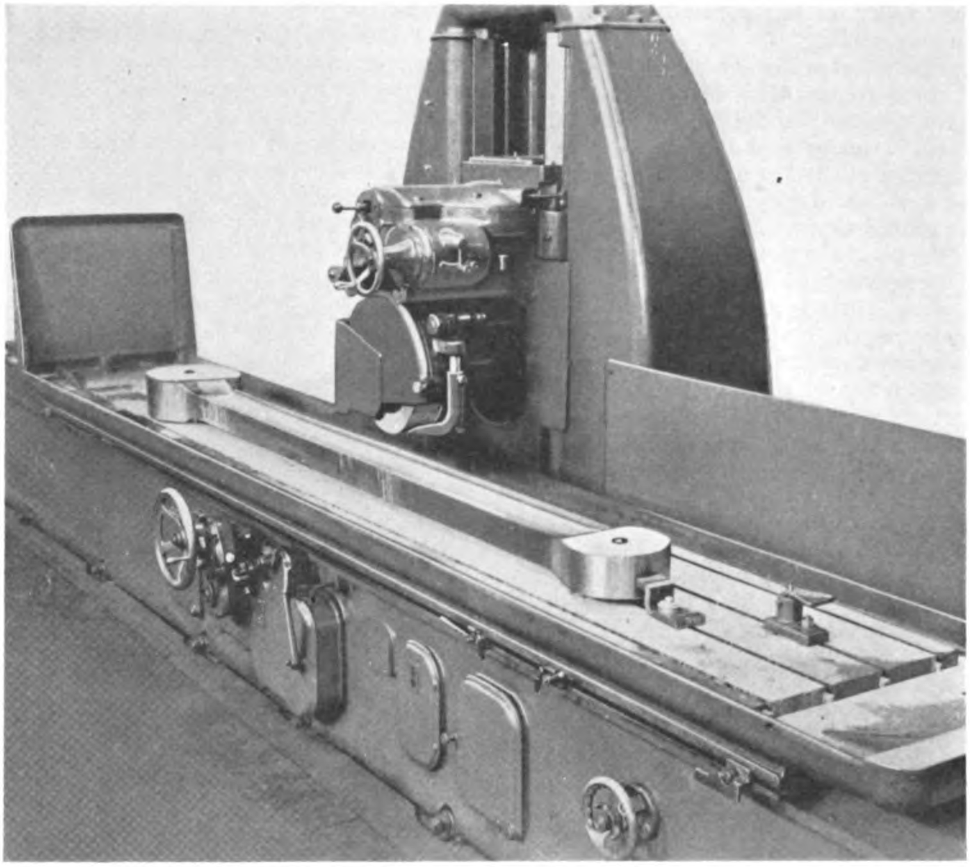
The successful application of metal spraying can only be obtained by a thorough knowledge of all the factors involved. The character of the part to be sprayed as a rule matters very little. However, each individual job must be studied carefully to determine whether or not service conditions to which it must be subjected will have no detrimental effect on surfaces bonded mechanically. It was apparent while making this study of metallizing in the railroad shop in question that its success has been due entirely to meticulous care and a thorough knowledge of the technique.

Precision Surface Grinding On a Large Scale

What is believed to be one of the largest precision surface grinders of its type ever built is the Mattison machine illustrated, which has a table capacity of 30 in. wide by 16 ft. long. The base length is 36 ft.; wheel clearance above table, 20 in. Being used in a railroad shop, it provides a table surface of sufficient size to accommodate large work which before could not be satisfactorily handled, and at the same time produces an accurate and fine finish. In addition, it permits grinding more pieces per set-up on regular sizes of work.

An outstanding characteristic of the Mattison surface grinder is the powerful built-in motor construction, with the rotor mounted directly on the wheel spindle and balanced as a unit. With this positive and direct form of drive, there is no vibration imparted to the wheel spindle, as may be the case with belts, chains, gears or other drive connections.

To remove successfully stock with a grinding wheel, it is also necessary to maintain full power. The instant the wheel slows down, due to slippage, cutting efficiency is lowered and capacity and quality suffer. On the surface grinder illustrated the motor delivers its full power direct to the wheel and there is plenty of reserve to insure full wheel speed for fast grinding.



Mattison 30-in. by 20-in. by 192-in. high-powered precision surface grinder

Other features of the machine are the double column mounting, hydraulic feeds and convenient operating controls. This type of machine is also supplied by the Mattison Machine Works, Rockford, Ill., with conventional table sizes from 12 in. by 36 in. up.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Cause of Wear of Exhaust Nozzle Bridge

Q.—We have a number of engines that had exhaust nozzles 6¼ in. in diameter, and single bars. We have changed the nozzle to 7 in. in diameter and are now using two bars. I notice since we made the change that the top of the two bars wear flat and the bottom that goes in the tip does not wear. These bars were diamond shaped when we put them in the tip. I would like to know why the top of these bars wears flat while the bottom doesn't.—B. C. H.

A.—The fact that the bars wear flat across the top would indicate the cause of the wearing is cinder cutting. Although the exhaust passes through the nozzle with considerable velocity, this does not necessarily indicate that the wear would take place at the bottom of the bars. It is not the exhaust steam, but rather the cinders passing over the tops of the bars which are cutting and wearing them flat.

The purpose of these bars is to increase the entraining area of the exhaust, that is, to spread the steam into segments, thereby giving a greater outside surface to the exhaust-steam jet when passing from the nozzle tip to the stack for sucking in the gases and cinders, thus making for a better draft.

As the exhaust steam passes these bars, the velocity of the steam causes a vacuum directly over the bar, due to the diamond-shaped bottom spreading the steam. When the steam is shut off, this vacuum is broken and the gases and cinders rush in to fill the vacuum causing a cinder-cutting action across the top of the bars.

Were the exhaust a constant flow, this condition would not exist, due to the fact that the vacuum would not be broken; however, with a locomotive the vacuum created by the exhaust over the bars is broken with each stroke of the piston, with the resultant cinder cutting eventually wearing the top of the bars flat.

Causes of Leaking Boiler-Check Studs

Q.—On our locomotives the boiler checks are located on the side of the boiler, the one on the right side being piped back to the injector, while the one on the left side is piped ahead to the feedwater heater. Considerable trouble is experienced with the check studs leaking. What causes this condition?—F. F.

A.—This condition is generally due to the difference between the expansion of the boiler and the expansion of the delivery pipe to the check valve. On the right

side, the injector is studded to the wrapper sheet and the check is studded to the boiler; therefore, the difference in the expansion of the boiler and the injector delivery pipe between these two points sets up a stress in the studs securing these parts. The delivery pipe stands away from the boiler, causing a moment arm on the studs securing the check to the boiler; hence, the continual working, due to expansion and contraction of the pipe, loosens the studs causing steam leaks.

Where there is considerable distance between the boiler check and the injector, and the pipe clamps securing the delivery pipe to the boiler are not clamped tight on the pipe, allowing the pipe to breathe, or where there is an offset in the pipe, which provides a place for the pipe to compensate for the unequal expansion and contraction, this condition is somewhat relieved. It can also be relieved by increasing the size of the studs securing the check to the boiler, giving a more rigid construction at this point.

This condition is generally not as severe on the feedwater-heater side, due to the fact that this pipe has a large bend where it goes up to the feedwater heater; however, care should be taken to prevent the pipe from being clamped tight in the clamps along the side of the boiler.

The Application of Aluminum Rivets

Q.—Should aluminum rivets be used in assembling aluminum parts such as cabs, rimboards, etc? Does the procedure for riveting aluminum parts vary to any great extent from that used in riveting the same parts made of steel?—B. B.

A.—Either steel or aluminum alloy rivets may be employed, steel rivets are stronger, but they should be used only when the parts are adequately painted. Aluminum-alloy rivets are employed where maximum resistance to corrosion and weight saving are essential.

Steel rivets in aluminum parts are applied in the same manner as for steel plates. They are heated to about 1,800 deg. F. and driven with as little delay as possible so as to make the driving easier. Where a large group of hot steel rivets occur closely spaced, it is good practice to avoid overheating the adjacent metal. This is usually done by driving the rivets at random rather than in succession. Sometimes it is necessary to cool the parts being riveted with water or compressed air. The temperature of the aluminum-alloy parts being riveted should never be allowed to rise above 300 to 400 deg. F., the exact temperature depending on the alloy.

The procedure for applying aluminum rivets in aluminum parts does not differ greatly from that used for steel rivets. Because the characteristics of the various materials used for the rivets differ, there is some difference in the driving methods employed for the rivets made from each of the aluminum alloys.

The properties of commercially aluminum rivets and some of the aluminum alloys are not improved by heat treatment and are always driven cold. Other aluminum alloys have their properties improved by heat treatment; consequently, rivets made from them should always be heat treated before or during the driving operations. For heat treating aluminum-alloy rivets, a reliable temperature indicator is essential in order to insure the required temperature control. When rivets are to be quenched in water for cold driving, the heating equipment generally consists of a bath of sodium nitrate heated by gas, oil or electricity. The rivets are handled in a basket made of wire mesh or perforated sheet and must be quenched quickly after removal from the heating bath. All nitrate must be washed off the rivets.

Aluminum-alloy rivets for hot driving are commonly heated in a load pot, or in an electrically heated air furnace. Automatic control of temperature is highly desirable in both types of equipment. The heating equipment must be near the work so that the temperature lost in transfer is minimized. When heating in a lead bath provision must be made to submerge the rivets in the bath; otherwise, they will float. All adhering lead should be removed by a sharp blow against some solid object, before the rivet is inserted in the hole.

In selecting the rivet alloy to be used it is good practice to use a rivet having about the same properties as the material in which it is driven.

In applying aluminum rivets, squeeze riveters are preferred, thus assuring properly upset shanks and well-centered heads. Pneumatic hammers are suitable for riveting aluminum-alloy rivets provided they are large enough to upset the rivets properly.

Aluminum-alloy rivets may be headed by means of a heavy hand hammer or sledge. This method has been found satisfactory for work which permits adequate bucking.

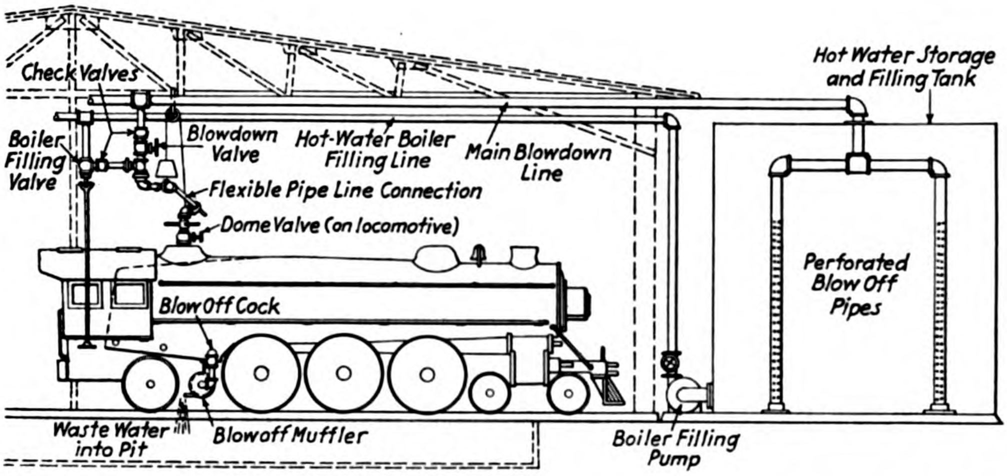
Rivet sets used for driving aluminum-alloy rivets should have smooth polished surfaces so that the metal will flow readily during the forming of the head. The bucking tools, especially those used with the large hammers, should have plenty of mass. The mass should be distributed close to the rivet head and be concentric with it. The cup on the bucking-up set should be slightly wider and shallower than the manufactured head so that the initial contact will be at the end of the head directly in line with the shank. This practice will prevent the shank from being driven up into the head and will greatly facilitate upsetting throughout the length of the shank.

Boilers Blown Down and Refilled Through Steam Dome

The Sturdevant system of reclaiming, washing, and filling locomotive boilers, illustrated in the drawing, was developed on the Southern Pacific by C. W. Sturdevant, assistant engineer of tests, San Francisco, Calif., and during the past few years it has been extended over the entire Pacific as well as Texas & Louisiana Lines of this company. Furthermore, since its initial use by the Southern Pacific it has been adopted and has been in use by the Western Pacific at all of their engine terminals.

This system is based upon the principle that the release of the steam from the boiler into a receiver at atmospheric pressure causes approximately one-third of the water in the boiler to be evaporated and carried over as steam and condensate into a main hot-water-storage tank as distilled water. Many tests of locomotives being serviced in enginehouses substantiate this large amount of pure water recovered. The system is immediately effective as soon as the locomotive is housed, the blowoff of the steam being quickly made from the locomotive steam dome at the top of the boiler through a flexible pipe conduit into a main overhead pipe line which leads into the reclamation receiver. Normal time of blowing down the boiler is about 45 minutes; however, the speed of blowdown may be varied by the control valve situated at the top of the steam dome and carried by the locomotive.

This method of blowing down the locomotive boiler



The Sturdevant system of reclaiming, washing and filling locomotive boilers

is particularly distinguished by the fact that the blowoff of the locomotive is made from the top of the boiler instead of through the blowoff cock. This prevents all sedimentary matter and foul water containing soluble salts from being discharged into heaters, pumps and pipe lines, thereby eliminating periodical cleaning of the system to rid it of objectionable extraneous matter and reducing the maintenance cost to a minimum. When the blowing off of the locomotive is completed and all pressure is out of the boiler, the remaining water in the legs and lower boiler portions is discharged through the blowoff cock or blowoff muffler into the locomotive pit. Washout plugs are then removed and the boiler washed, preferably with hot water from the main storage reclamation tank, although recovery of the waste water into the locomotive pit can, if desired, be made in a sump pit and used for washing purposes.

In washing boilers the temperature of the water on the discharge side of the washing pump is blended down to a temperature of approximately 120 deg. F., which is as hot as the boiler washers can handle it. After the boiler is washed, washout plugs replaced and the blowoff cock closed, the boiler is then filled with hot water from the main storage tank, at approximately 180 deg. F.

Filling of the boiler is made at the top of the boiler through the dome and by the same flexible pipe connections as previously used for blowing off the steam from the boiler, there being an arrangement of by-pass and shut-off valves, as shown in the drawing, which permits the hot boiler filling water to be discharged from the boiler filling pump through the enginehouse pipe line directly into the top of the boiler. In other words, the steam is removed from the boiler and hot water subsequently replaced in the boiler through the same connection at the top of the steam dome. This method of filling the boiler eliminates filling through the blowoff cock and does away with the blowoff hose and connections now commonly used for this purpose. Present enginehouse piping, with slight modifications, can be made to accommodate the Sturdevant system.

From the foregoing it will be obvious that the receiver into which the steam from the locomotive boiler or boilers is discharged also provides the hot-water storage from which they are refilled. The filling water in the receiver is of an excellent character, being composed of distilled water (condensate) from the initial blowoff of the locomotive and makeup water as may be required from the source of water supply.

Another outstanding advantage is claimed for the Sturdevant system by reason of the removal of the steam before the removal of the water from the boiler, namely, the retention of the water in the legs of the firebox during the blowoff period. This permits the firebox sheets and staybolts to cool down gradually and without subjecting these highly-heated portions to rapid strains of expansion and contraction.

This arrangement described is being placed upon the market by J. C. Martin & Company, Engineers and Manufacturers, Los Angeles, Calif.

Tantalum-Carbide Alloy For Metal-Cutting Tools

The Fansteel Metallurgical Corporation, North Chicago, Ill., has developed a hard cutting-tool and wear-resisting alloy known as Tantaloy. It is a general-purpose hard metal ordinarily used as a tip which is brazed to a steel shank to form a cutting tool. Containing tanatalum carbide, Tantaloy is said to possess the characteristics of a high degree of chip slippage which resists the development of crater by the chip action. When regrinding, these tools require very little metal removal, thus decreasing the grinding time and increasing the useful life of the tool. An outstanding characteristic is toughness, making Tantaloy-tipped tools efficient for service ordinarily regarded as severe, such as interrupted cuts, heavy feeds, varying hardness of metal, or tool mounting essentially deficient in rigidity.

These tools are available in all standard lathe, boring-mill and turret tool sizes; also the metal is available in tips which may be brazed to boring bars, counterbores, or special tools. Tantaloy is recommended for gages, lathe center, centerless grinder rests, wearing surfaces, and the general field of application of abrasion- and corrosion-resisting metal.

Tantaloy, a tantalum carbide alloy, brazed to a steel shank

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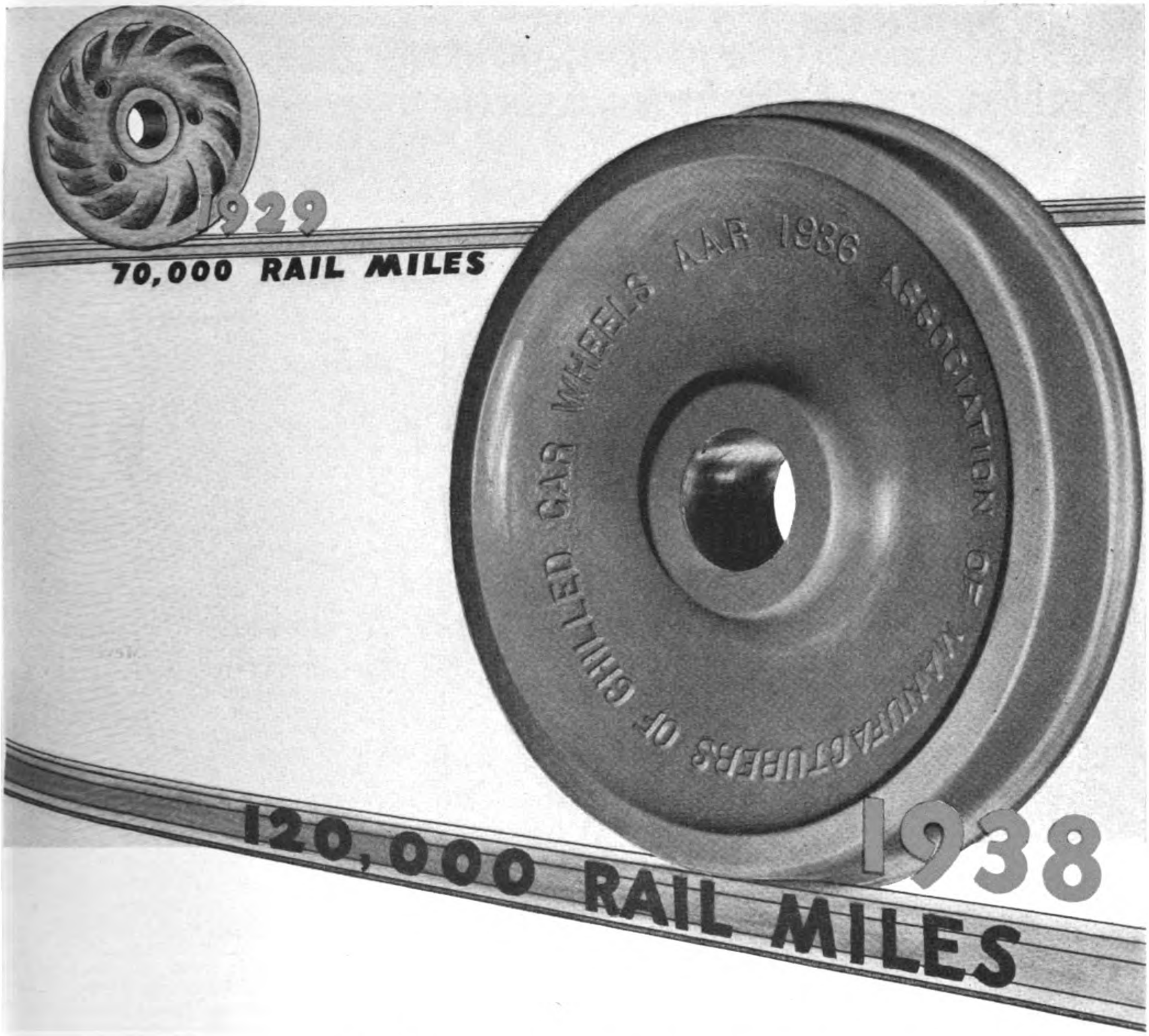

Measured in rail miles, Chilled Car Wheels are 40% better today. Improvements in design, in manufacturing methods, and in control of operations in Member Plants have resulted in a steady increase of miles of service delivered by Chilled Car Wheels over a period of 10 years. But our aims are not yet fully attained. Research and careful inspection will go on to the end that, "Every wheel shall be as good as the Best," and the best shall be capable of still higher standards of performance.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE,
NEW YORK, N. Y.

445 N. SACRAMENTO BLVD.,
CHICAGO, ILL.

ORGANIZED TO ACHIEVE:
Uniform Specifications
Uniform Inspection
Uniform Product

High Spots in

Railway Affairs . . .

Lea's Bill In the House

Clarence F. Lea of California, chairman of the Committee on Interstate and Foreign Commerce of the House of Representatives, has introduced what is well designated as an omnibus bill. It is based largely on the reports of the Splawn-Eastman-Mahaffie Committee and the Committee-of-Six, and is apparently intended as something to "shoot at" in the attempt to draw out constructive recommendations from all interested parties through an extensive series of hearings begun in Washington on January 24. Chairman Lea has given much intelligent study and thought to the transportation problem while in Congress and can be depended upon to give real leadership to his committee. In opening the hearings he concluded with this statement: "This committee will, to the extent of its ability, prepare transportation legislation with a view of dealing justly with our various types of transportation; so far as there is a practical legislative remedy, endeavor to relieve the economic stress from which these agencies now suffer; and attempt to serve the public interest of the country by this legislation."

The Administration And the Railroads

Twice within a week, on January 16 and again on January 23, President Roosevelt held White House conferences to discuss the railroad problem, at which Senator Wheeler, chairman of the Senate Committee on Interstate Commerce, and Representative Lea, chairman of the House Committee on Interstate and Foreign Commerce, were present. Quite apparently the Administration is impressed with the necessity for really doing something with the railroad question at this session of the Congress. Representative Lea is already at work in the House, as indicated elsewhere in this column. At this writing it is not clear just what action Senator Wheeler and his committee will take. The Senator has indicated that he is not in "violent disagreement with the Lea Bill." From what he has said, it is quite likely that he will introduce bills in the Senate to reorganize the Interstate Commerce Commission and to give that body authority to regulate water carriers. It seems that he is still opposed to the repeal of the long-and-short-haul-clause of the Interstate Commerce Act's Fourth Section. In light of the performance of Senator Wheeler and his committee in the last Congress, it would appear that the House Committee will have to be the pace setter in any really worth while endeavor to enact a comprehensive and constructive legislative program.

R. B. A. for a Subsidy

Naturally the Railway Business Association, made up of members of the railway manufacturing and supply industry, is taking a keen interest in proposed legislation for the relief of the carriers; indeed, the welfare of its members depends upon railroad prosperity. Among other things, it believes that the present emergencies are so great that ordinary legislative action cannot bring relief soon enough, so that for a while at least, the railways, and particularly the weaker ones, should be given a subsidy in the interests of national defense. It suggests that the subsidy might well be based upon a certain proportion of railway expenditures for maintenance of way and structures during each year, beginning with 1939. It is estimated that such a subsidy might range between $100,000,000 and $200,000,000 a year, and might be continued for a limited period of from three to five years. The R. B. A. also believes that greater economies should be practised by the railroads and suggests that this can best be accomplished by a program which will permit orderly consolidations in such a way as to realize substantial operating economies.

Postalized Railroad Rates

Considerable furore has been stirred up by full-page advertisements in a few large daily newspapers, presenting the claims of the Hastings postalized rate plan. John A. Hastings, a former member of the New York State Senate, first made his proposal several years ago. In 1935 Chairman Wheeler of the Senate Committee on Interstate Commerce, asked Co-ordinator Eastman to give the matter consideration. The co-ordinator reported back to the senator that it would be well for Congress to direct the I. C. C. to study and report on all such plans. No action was taken by Congress. Mr. Hastings and his backers—whoever they may be and for whatever reason—have succeeded in stirring up Senator Wheeler again. Chairman Marion M. Caskie of the Interstate Commerce Commission, in replying to the senator, has again suggested the desirability of a mandate to the Commission from Congress, authorizing it to study the plan and report back. Briefly, the scheme divides the country into nine postalized fare regions, with a flat rate for passenger travel within any one region. That the scheme is considered experimental is indicated by the fact that the government is asked to guarantee the railroads against loss of passenger revenue. The plan also contemplates similar treatment of freight charges eventually. Railroad men do not favor the plan and the National Transportation Conference is quite definitely opposed to it.

Old Men Not Wanted on I. C. C.

An Interstate Commerce Commissioner is appointed for a term of seven years and until his successor is confirmed. Because of his action in criticizing the "nine old men" on the Supreme Court, President Roosevelt apparently has a problem on his hands with the I. C. C. commissioners. A year ago the terms of Frank McManamy and Charles D. Mahaffie expired. Mahaffie was reappointed, but McManamy, who will reach seventy in 1940, has been riding along since, no intimation having been given to the public by the President as to what action he may finally take. This year the terms of Balthasar H. Meyer and William E. Lee expired. The President has indicated his purpose to replace Meyer, who is 72 years old and is familiarly termed the "dean" of the Commission because of having served longer on it than any other commissioner in I. C. C. history. No action has yet been taken in the case of Lee, who is still in his fifties. He has been a member of Division V, the Motor Carrier Division, and has been endorsed for reappointment by the executive committee of the American Trucking Associations, Inc.

Can Amlie Qualify?

Just what influenced President Roosevelt to suggest the appointment of Thomas R. Amlie to succeed Balthasar H. Meyer on the Interstate Commerce Commission is difficult to imagine. He could not appoint a Democrat and so suggested an extreme left-winger—a "lame duck" and former congressman who was defeated last year for senatorial nomination in the Wisconsin Progressive primary. The President's action raised a storm of protest and criticism throughout the nation. Both houses of the Wisconsin Legislature immediately passed resolutions asking the President to withdraw the nomination, and calling upon the Senate to refuse confirmation if the President refuses. Roosevelt was clearly irritated when questioned about Amlie at the press conference on January 24. How much longer will the intelligent American public allow the politicians to continue making a football of the railroads?

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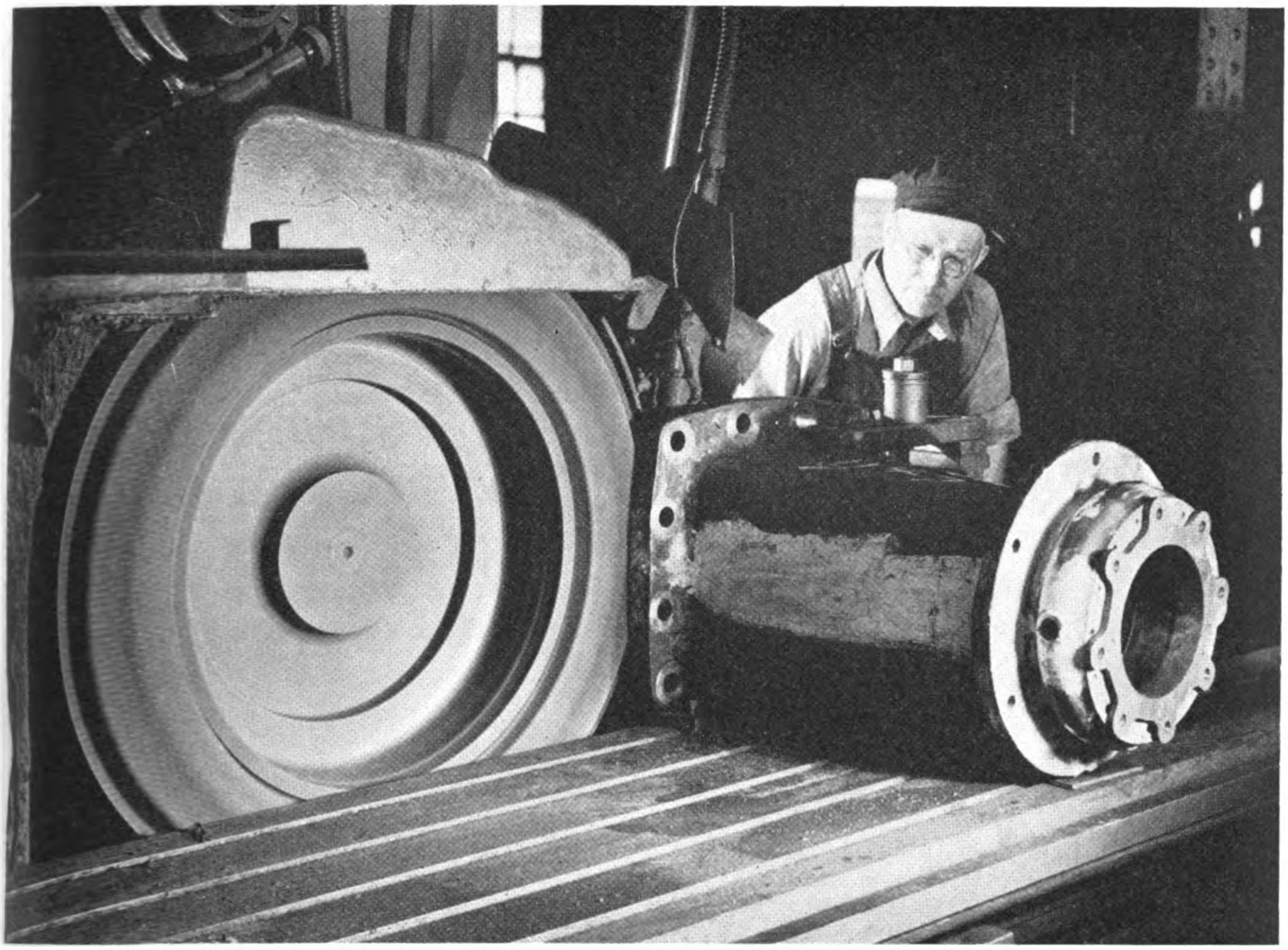
METHODS AND MACHINERY THAT GUARD LIMA QUALITY



How A Tight Joint Gets Its Start

Where joints are under pressure Lima grinds the fits to a smooth, even surface that can be made steam tight and kept that way. » » » By such attention to details Lima has won a reputation for soundness of construction that backs up its leadership in locomotive design.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

Among the Clubs and Associations

Car Department Association of St. Louis.—"Wheel Defects, Particularly Those Defects Not Covered by A. A. R. Wheel Gages" will be the topic to be discussed by D. R. Brown of the Southern Wheel Company at the meeting on February 21 at the Hotel Mayfair, St. Louis, Mo. Of especial interest will be the presentation by F. H. Hardin, president of the Association of Manufacturers of Chilled Car Wheels, of the talking motion picture, "The Story of the Chilled Car Wheel." Dinner will precede the meeting at 6:15 p. m.

Central Railway Club of Buffalo.—"Freight Loss and Damage" was the feature of the meeting held on February 9 at the Hotel Statler, Buffalo, N. Y.

New England Railroad Club.—J. Roberts, chief of motive power and car equipment of the Canadian National, will be the speaker at the meeting to be held on February 14 at the Hotel Touraine, Boston, Mass. Mr. Roberts' topic will be "Railway Equipment Maintenance—Modern Practice vs. Obsolescence Waste." The meeting, "Canadian Night," will start with dinner at 6:30 p. m.

Toronto Railway Club.—The February 27 meeting will be "Maintenance of Way Night." It will be held at 7:45 p. m. at the Royal York Hotel, Toronto, and A. O. Wolff, assistant district engineer, of the Canadian Pacific, and B. Wheelwright, engineer maintenance of way, of the Canadian National, will be the speakers.

Southern and Southwestern Railway Club.—At the meeting at 10 a. m. on March 16 at the Ansley Hotel, Atlanta, Ga., W. L. Rice, superintendent of shops of the Reading Company, Reading, Pa., will present a paper on Practical Shop Operation.

Car Foremen's Association of Chicago.—A continued discussion of the new A. A. R. Rules of Interchange and proposed changes in them for 1940 will feature the February 13 meeting to be held at the LaSalle Hotel, Chicago, at 8 p. m.

Northwest Car Men's Association.—"The Story of the Chilled Car Wheel," the sound moving picture of the Association of Manufacturers of Chilled Car Wheels, was presented by a representative of the Griffin Wheel Company at the meeting of the Northwest Car Men's Association on February 6. Proposed changes in the new A. R. A. rules were also discussed.

Railway Club of Greenville.—G. S. Meek, president and general superintendent of the Pittsburgh & Conneaut Dock Company, will be the speaker at the meeting to be held at 6:30 p. m. on February 16 in Bessemer Hall, B. & L. E. shops, Greenville, Pa. His topic will be "The Story of Unloading Iron Ore at Conneaut, Ohio."

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—Rule 32 was discussed by F. M. Rezner at the meeting held on the afternoon of February 9 at the Union Pacific shops, Council Bluffs, Iowa.

Eastern Car Foreman's Association.—The annual dinner and entertainment of the Eastern Car Foreman's Association was held in the East Ball Room of the Hotel Commodore, Thursday, February 9 at 7 o'clock. The arrangements were made by J. P. Egan, President, who headed a committee of 14 members.

Club Papers

Chilled Wheels in Pictures

New York Railroad Club.—Meeting held January 20 at New York. Presentation of moving picture, "The Story of the Chilled Car Wheel," and remarks by F. H. Hardin, president, Association of Manufacturers of Chilled Car Wheels. ¶ A comprehensive review of the modern process of producing chilled-iron car wheels was presented by Mr. Hardin in the form of a sound moving picture. The picture followed through the various steps in the production process, beginning with the preparation of the scrap wheels for the cupola, through the preparation of the molds, the manufacture of cores and the shaking out and pitting of the castings, to their final finishing on the boring mill. It also presented a number of operations in the well-equipped research laboratory maintained by the association. The story of the narrator which accompanies the film guides the reader in non-technical language through the steps in the process and brings out the extent to which scientifically accurate controls are replacing rule-of-thumb methods in the industry. ¶ In his talk before the picture was shown Mr. Hardin called attention to a number of points in the film which had raised questions where it had been previously shown. The temperature of the melted iron, he said, was kept as nearly as possible up to 2,700 deg. F. and poured at a temperature of around 2,450 deg. F. He also referred to the use of instruments for the control of cupola operation which are a development of the association's research organization. These were first developed in the form of a recording carbon-dioxide meter and a separate recording air-flow meter, the control to maintain uniform carbon dioxide being manual. Later the two recording instruments, he said, were coupled up and are now operating as an automatic control, by means of which constant carbon dioxide is maintained by automatically varying the air volume. ¶ In referring to the breaking of wheels to check the depth of chill by visual inspection, Mr. Hardin pointed out that it is now possible to combine the physical, chemical and metallurgical characteristics and develop a scientific method of determining the depth and wear value of the chill without the necessity of visual inspection. ¶ One of the most important improvements in the production of chilled-iron wheels is the new low-heat-capacity annealing pits which are replacing the old type sand pits. These unit pits stand in the open surrounded by air and each consists of a steel shell lined with an efficient insulating material. The wheels are pitted at a high temperature; the hub and tread diameters are equalized well above the critical point, and then are cooled at a rate of 8 to 10 deg. per hour. No firing is necessary, neither is a transfer of wheels from one pit to another at lower temperature to effect cooling. No matter how long the wheels stay in the pit, they will not be over-annealed.

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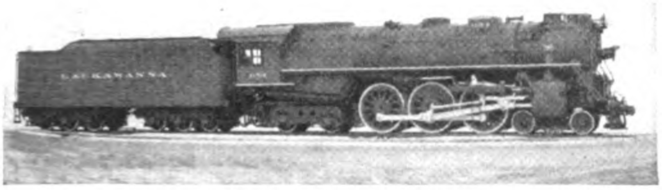
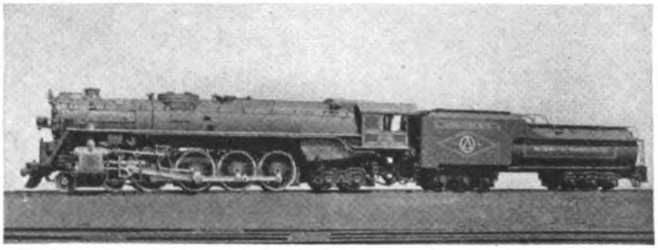
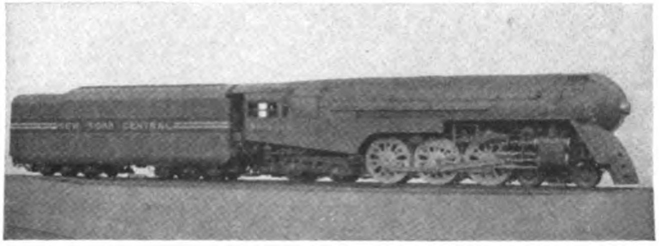


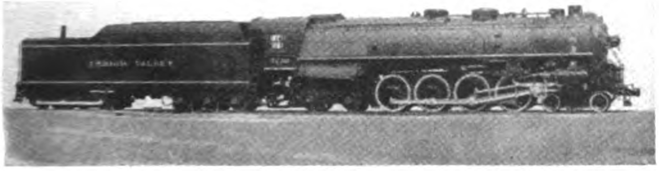
Delaware, Lackawanna & Western R. R.



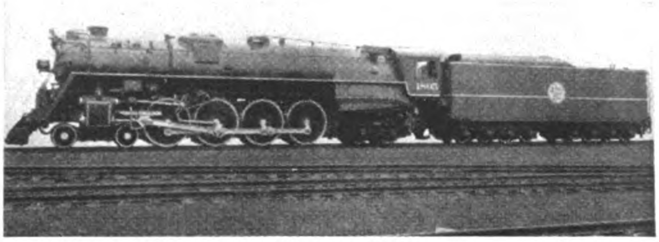
Richmond, Fredericksburg & Potomac R. R.



New York Central System



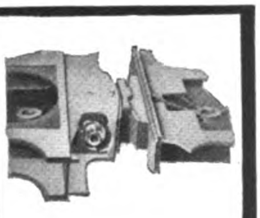
Lehigh Valley R. R.



Atlantic Coast Line R. R.

E-2 Buffer provides better riding, greater safety, and lower maintenance

The Franklin E-2 Radial Buffer eliminates all slack between engine and tender, thus absolutely preventing one of the principal causes of hard riding. » » » It permits full freedom of movement, laterally and vertically, and cannot get into improper position. It will not interfere with proper tracking of the engine, thus insuring greater safety. » » » Because it eliminates excessive vibration and greatly reduces the number of pipe failures, loose cabs, and other related defects, the cost of maintenance is greatly reduced. The E-2 Buffer pays for itself quickly.

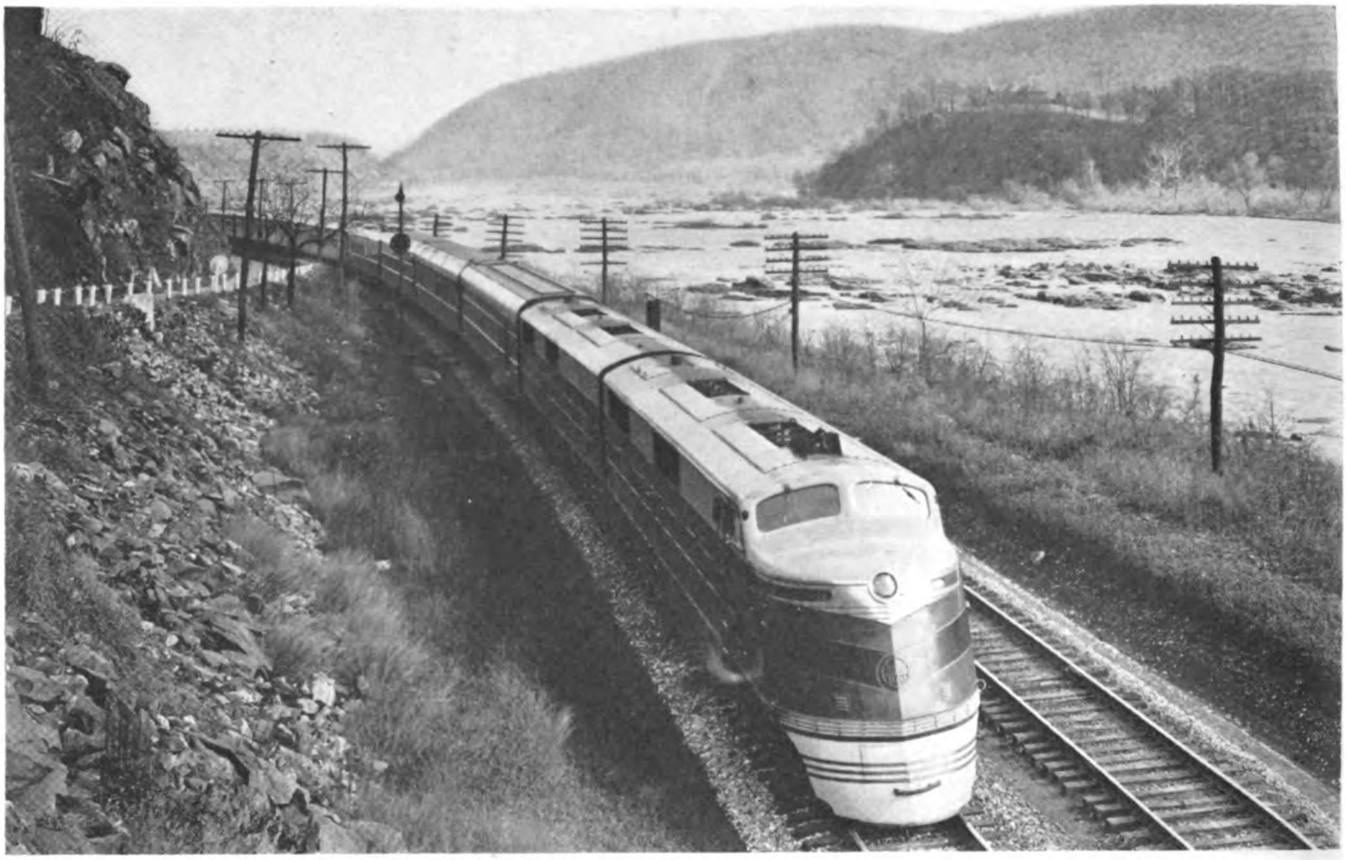


Franklin Type E-2 Radial Buffer dampens oscillation between engine and tender and makes for easier riding.

REG. U.S. PAT. OFF.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL



The newly streamlined Capitol Limited of the Baltimore & Ohio in the picturesque Potomac River Valley near Sandy Hook, Md., en route to Chicago from Baltimore, Md.

NEWS

Bureau of Safety Annual Report

During the year under review in the annual report of W. J. Patterson, director of the Bureau of Safety, Interstate Commerce Commission, Washington, D. C., a total of 1,213,081 cars and locomotives was inspected; 29,286 or 2.41 per cent were found defective as compared with the 2.31 per cent defective out of the 1,203,752 inspected in 1936-37. While last year's showing was thus less favorable than that of the previous year it was better than the record for 1935-36 when 2.44 per cent of the rolling-stock units inspected were found defective.

During the fiscal year there were 1,469 collisions and 3,823 derailments reported to the I. C. C.; in these, 195 persons were killed and 1,115 injured, as compared with 210 killed and 1,277 injured in the 1,940 collisions and 5,050 derailments reported in the previous fiscal year ended June 30, 1937.

Air-brake tests on 2,753 trains prepared for departure from terminals showed the air brakes on 99.9 per cent of the cars operative. It was necessary to set out cars or repair the brakes on an average of three cars for practically every five trains tested by the inspectors. Similar tests on 829 trains arriving at terminals showed that brakes were operative on 98.12 per cent of the cars—the cars with inoperative brakes averaging slightly less than one per train.

The report notes that the work of equipping cars with AB brakes is behind schedule. Attention is directed to the fact that during 3½ years, or 35 per cent of the 10-year period, only 11.3 per cent of the freight cars in interchange service have been equipped with the present standard air-brake apparatus. The reports show that 13 railroads and 19 private car lines have 30 per cent of their cars so equipped; but "107 railroads and 122 private car lines have not as yet reported any cars so equipped."

"Material improvement has been noted in the efficiency of hand-brake equipment on passenger cars, as a result of the adoption of rules . . . governing inspection and maintenance" of such equipment. Also, "co-operative efforts" with the A. A. R. have continued "for improving the conditions of couplers, draft gears and their attachments and supports." During the 15 months prior to June 30, 1938, there was no accident investigated by the Bureau in which free slack in draft gears or defective supports was found to be the cause or a contributing factor. "However," the report adds, "the large number of break-in-twos of trains, due to slipovers of knuckles, indicates that additional improvement is essential." The Bureau has called the A. A. R.'s attention to the "urgent need" for establishing "a standard and a maximum permissible vertical movement of the coupler head from the position at which its standard height is determined."

Discussing the arch-bar truck the report cites a December, 1937, accident wherein "the hazard of their use was again forcibly demonstrated." "Accumulated experience," the report adds, "plainly indicates the need of extreme precautions with these obsolete trucks during their remaining period of service."

As in other recent years the report includes a brief discussion of braking methods and apparatus for high-speed streamlined trains. After noting that the Bureau has joined with the railroads and brake manufacturers in several tests, the report adds: "Brake performance on high-speed trains in service has not developed results on a parity with results obtained on conventional equipment at lesser speeds. Means of preventing destructive temperatures of both the brake shoes and the wheels resulting from the increase of braking force necessary to control trains oper-

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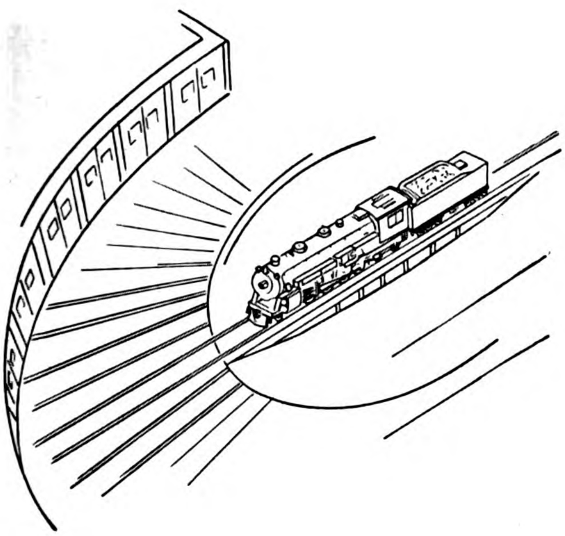
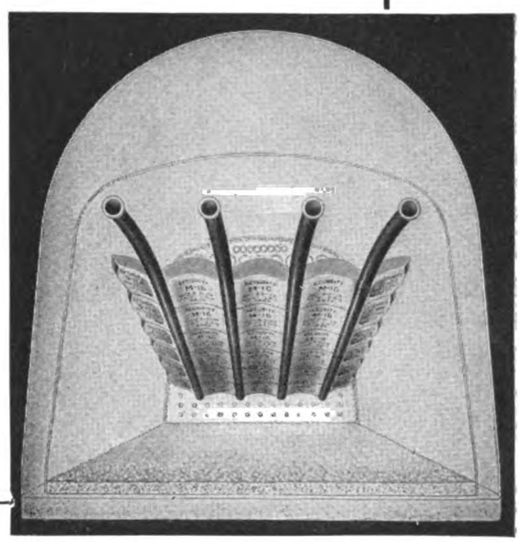
BE SURE No Arch Brick Is Missing





There's More to SECURITY ARCHES *Than Just Brick*

In these days of rigid economy, don't draw the line too fine and let a locomotive leave the roundhouse with an imperfect Arch due to lack of supplies.

A single missing Arch Brick has a mighty serious effect on steaming and on the efficiency of the locomotive.

Today, a dollar's worth of fuel means more than ever before. To spend it effectively, every Locomotive Arch should be maintained in perfect condition.

Be sure your stocks on hand are ample to provide fully for all locomotive requirements, so that locomotive efficiency will not suffer.

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.

Locomotive Combustion Specialists

ated at extremely high speeds so as to maintain a degree of efficiency and safety equivalent to that provided at the lower speeds which generally prevail have not been satisfactorily developed. Experiments employing means other than applying the braking force to the treads of the wheels and thereby relieving the wheels of the dangers incident to excessive heating, are also being carried on and the results are being duly observed and considered by the Bureau. Experiments and tests in both service and emergency braking on high speed trains will be continued in order to determine the greatest degree of efficiency which it is practicable to attain."

Contemplated Expenditures for New Equipment and Betterments

New York, New Haven & Hartford.—The federal district court at New Haven, Conn., has authorized the trustees of this road to make expenditures totaling $1,514,158 for replacements and new equipment.

Missouri Pacific.—The federal district court at St. Louis has authorized the trustee of the Missouri Pacific and subsidiaries to spend $8,560,864 for betterments and improvements to roadway, shop buildings, motive power and car equipment, etc. Of the total amount $4,988,211 is chargeable to capital account.

In another petition not yet approved, the trustee suggested that an additional $4,623,000 be spent by the Missouri Pacific for two 900-hp. Diesel-electric locomotives for use on its Union-Lincoln lines, costing $198,000; three 900-hp. and two 600-hp. Diesel-electric locomotives for use in the St. Louis terminal, costing $381,000; two streamlined trains, $360,000 for the locomotives and $984,000 for the cars; and 1,000 50-ton flat bottom gondola cars, costing $2,700,000; and 200 50-ton box cars and 50 50-ton coal cars, costing $860,000, for the Missouri & Illinois.

St. Louis-San Francisco.—A petition to spend $1,311,700 for additions and improvements on the Frisco, has been approved by the district court. Of this amount, $998,103 will be used for roadway improvements and $313,617 for mechanical improvements. Five locomotives will be rebuilt in the company's shops at Springfield, Mo.

Chicago, Rock Island & Pacific.—The budget of the Rock Island for 1939 provides for expenditures aggregating $32,412,000 for improvements of roadway and equipment and maintenance, exclusive of expenditures for new equipment, a budget for which has not yet been completed, improvements to engine terminals, electrification of shop machinery and tools, and the modernization of fueling facilities and water stations are also provided for. Besides these expenditures, there is a carry-over of $1,500,000 from the 1938 improvement budget.

The equipment improvement program included in the $32,412,000 budget provides for the application of roller bearings and new engine trucks on locomotives, and for new locomotive tenders and tanks of increased capacity. It also provides for the application of stokers to locomotives not already equipped. It further provides for modernization and improvements to passenger-train cars, and the re-building of some freight equipment.

The Rock Island is also considering the purchase of streamline trains for use between Chicago and Denver, Colo.

F. K. Vial Awarded First Prize in Instrumentation Contest

F. K. Vial, vice-president in charge of research of the Association of Manufacturers of Chilled Car Wheels, was awarded the first prize of $200 in the first Instrumentation Contest sponsored by the Industrial Instrument Section of the Scientific Apparatus Makers of America, Chicago. The contest, conducted by Richard Rimbach, publisher of Instruments, was open to engineers or operating men not employed by an instrument manufacturer, and essays were to describe "an unusual application of a standard instrument or control device, telling briefly what conditions or need impelled the application." "Instrument or control device" was defined as "any device used for measurement and control, or any accessory used with a device for measurement and control."

Mr. Vial's paper was on the Automatic CO_2 Compensator for Cupola Control, which is a pioneer application of automatic combustion control to the cupola.

New Equipment Orders and Inquiries Announced Since the Closing of the January Issue

Locomotive Orders

Company	No. of Locos.	Type of Loco.	Builder
Erie	2	600-hp. Diesel-electric	Electro-Motive Corporation
Ft. Worth Belt	1	600-hp. Diesel-electric	Electro-Motive Corporation
C. & N. W.	2[1]	....	Electro-Motive Corporation

Locomotive Inquiries

Company	No. of Locos.	Type of Loco.	Builder
Southern Pacific	28	4-8-8-2 type	....
	12	2-8-8-4 type	....

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
U. S. Navy Department	3	60-ton flat	Haffner-Thrawl Car Co.

Freight-Car Inquiries

Road	No. of Cars	Type of Car	Builder
John Morrell & Company	100	Refrigerator	....
Great Northern	25	16,000-gal. tank	....
Mexican Government Railways	10	50-ton flat	....
	10	50-ton gondola	....
National Tube Company	6	70-ton hopper	....
	1	70-ton gondola	....
Pittsburgh & West Virginia	300	55-ton hopper	....
	100	50-ton steel box	....
Union Pacific	1,000-2,000	50-ton box	....
	300	50-ton flat	....

Passenger-Car Orders

Road	No. of Cars	Type of Car	Builder
Chicago & North Western	See footnote.[1]		
Pennsylvania	5[2]	Dining	Edward G. Budd
	12[2]	Coaches	Edward G. Budd
	5[2]	Dining	Pullman-Std.
	5[2]	Dining	American Car & Fdry.

Passenger-Car Inquiries

Road	No. of Cars	Type of Car	Builder
Union Pacific	10-15	Chair	....

[1]The Chicago & North Western has ordered two light-weight streamline Diesel-electric passenger trains for its "400," operating between Chicago and the Twin Cities, authority for the purchase of this equipment being granted by the United States District Court at Chicago on January 24. The two Diesel-electric locomotives are being built by the Electro-Motive Corporation at a cost of $720,000. Each of the two units will contain four 1,000-hp. engines. They are designed for operation without turn around thereby make two trips daily. The 20 cars costing $1,600,000, have been ordered from the Pullman-Standard Car Manufacturing Company. The consists of each train include a taproom-lounge car, four coaches, one dining car, three parlor cars and one observation-club car. The capacity of each train will be 409 seats excluding accommodations in smoking rooms, but including 56 seats in coaches, 27 in each parlor car, 56 in the diner, 12 in the parlor-lounge-observation car and 36 in the taproom lounge.

[2]These diners and coaches are to augment the equipment of "Blue Ribbon" east and west through trains and are to be fully streamlined. The Budd-built equipment will be fabricated of stainless steel. The Pullman-Standard cars will be of aluminum alloy, and five by the American Car & Foundry Co., of high tensile steel. The cost of the new equipment will be about $2,100,000. In addition, there are under construction at the Budd plant 2 new streamlined steel coaches which will be ready for delivery in the next few weeks.

Equipment Depreciation Rates

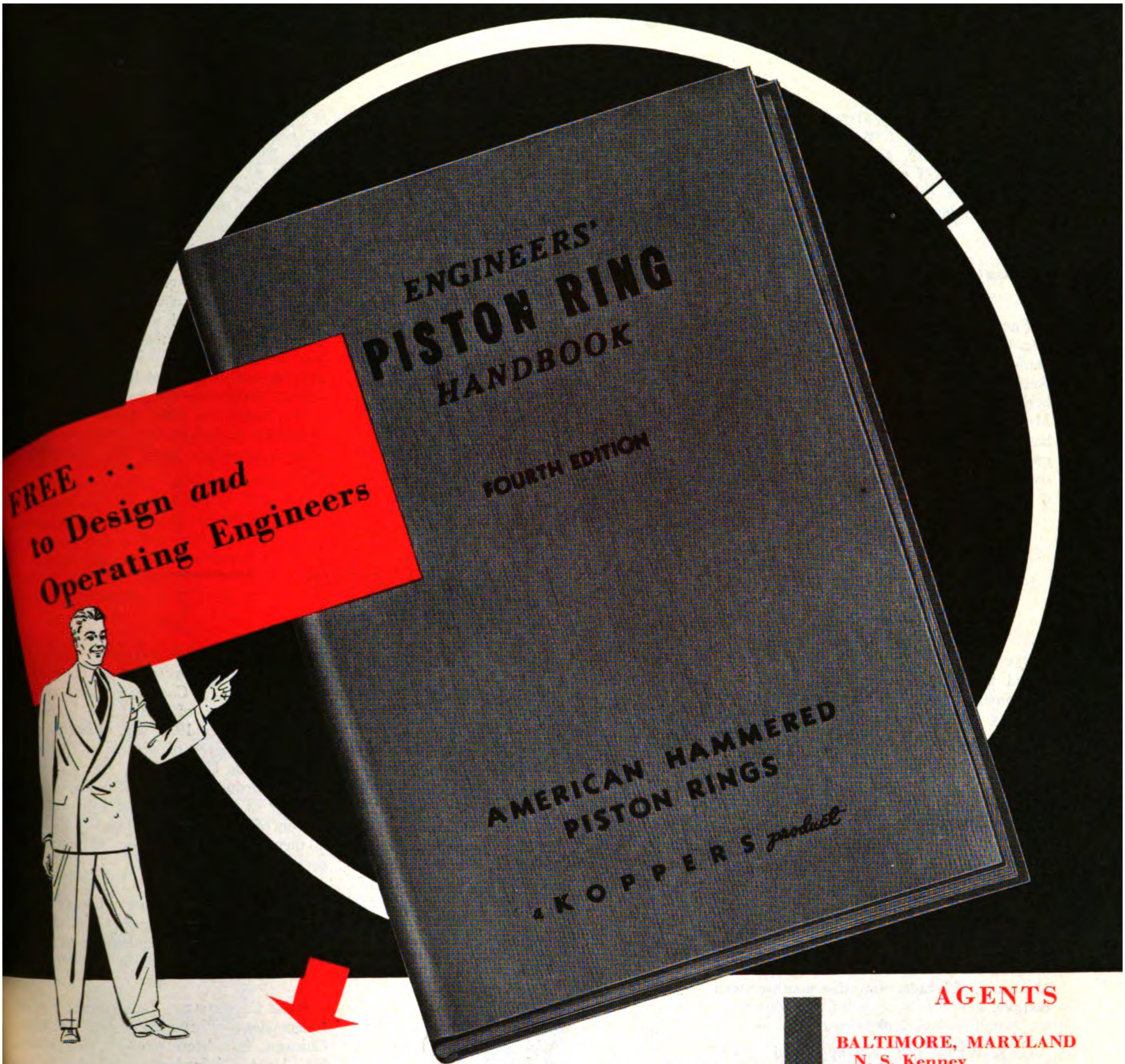
Equipment depreciation rates for fourteen railroads, including the Union Pacific, the Minneapolis, St. Paul & Sault Ste. Marie, and the Akron, Canton & Youngstown, are prescribed by the Interstate Commerce Commission, in two other series of sub-orders and modifications of previous sub-orders in No. 15,100, Depreciation Charges of Steam Railroad Companies. The composite percentages, which are not prescribed rates, range from 3.37 for the Cheswick & Harmar and the Sumpter Valley, and 3.42 for the Soo Line to 22.89 for the Bowdon. The latter is also the Bowdon's prescribed rate for passenger-train cars, since the present sub-order, a modification of a previous one, covers only that class of equipment. The A. C. Y.'s composite figure was 4.03.

The A. C. & Y.'s prescribed rates are as follows: Steam locomotives, 3.55; freight train cars, 5.69; passenger train cars, 3.83; work equipment, 3.61; and miscellaneous equipment, 17.96.

The Union Pacific's composite percentage of 3.96 is derived from prescribed rates as follows: Steam locomotives, 3.9 per cent; other locomotives, 7.19 per cent; freight-train cars, 3.81 per cent; passenger-train cars, 3.94 per cent; floating equipment, 4.9 per cent; work equipment, 5.09 per cent; miscellaneous equipment, 15.39 per cent. These rates cover also equipment leased from the Los Angeles & Salt Lake; the Oregon Short Line; the Oregon-Washington Railroad & Navigation; and the St. Joseph & Grand Island.

The Soo Line's prescribed rates are as

(*Continued on next left-hand page*)



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follows: Steam locomotives, 3.05 per cent; freight-train cars, 3.08 per cent; rebuilt freight cars, 5.27 per cent; second-hand freight cars, 5.71 per cent; passenger-train cars, 2.8 per cent; work equipment, 3.58 per cent; miscellaneous equipment, 9.8 per cent.

Senate Gets Reed Nomination for Retirement Board

President Roosevelt has sent to the Senate the name of M. Roland Reed for confirmation as a member of the Railroad Retirement Board for the five-year term beginning August 29, 1938. Since that date Mr. Reed, who succeeded James A. Dailey, has been serving as the Board's "railroad" member. A former superintendent of motive power on the Pennsylvania's Eastern Pennsylvania division, he was nominated by the Association of American Railroads, while 137 of the American Short Line Railroad Association's 310 members favored the reappointment of Mr. Dailey. The President followed the A. A. R. recommendation.

Inventor of Rotary Snow Plow Dies at 88

John S. Leslie, designer of the first successful rotary snow plow, the main features of which are embodied in modern apparatus of this type, died on January 10 at his home in Paterson, N. J., at the age of 88, after a long illness. While J. W. Elliott originally devised the rotary principle in snow-fighting equipment in 1869, it was Mr. Leslie who designed the first practicable machine embodying rotary motion and the cutting wheel of Orange Jull, which was tested by the Canadian Pacific at Parkdale, Ont., in 1883. This design was improved by changes in the knives and the addition of rail ice-cutters in a plow built by the Cooke Locomotive Works and put in service by the Chicago & North Western in 1885. In 1886 this plow was further refined by the substitution of a single fan wheel for opposite revolving wheels and was tried out on the Union Pacific in a test conducted personally by Mr. Leslie. Rotary plows have since grown larger and heavier, but the essentials remain as designed by J. S. Leslie.

Mr. Leslie, in 1905, founded the Leslie Company, manufacturers of valves, and remained president until his retirement in 1926.

Supply Trade Notes

Revere Copper & Brass, Inc., has completed a $3,250,000 brass and copper mill at Rome, N. Y. The mill has a monthly capacity of 2,000,000 lb. of brass strip up to 20 in. in width.

◆

Louis J. Galbreath, head of the Product Development Department of Revere Copper and Brass, Inc., has been appointed technical adviser for the New York district sales division, with headquarters at 75 E. 45th street, New York City.

◆

J. B. Peddle, St. Louis, Mo., has been placed in charge of sales of the railway division of the Morton Manufacturing Company, Chicago, for the southwestern district.

◆

G. J. Weber has been appointed executive assistant to president, Association of Manufacturers of Chilled Car Wheels, Chicago, also continuing in his present position as secretary of the association.

◆

The Pacific Car & Foundry Co., has moved its Seattle, Wash., office to 220 West Hudson street.

◆

The Ohio Brass Company has moved its Chicago office from 20 North Wacker Drive to 231 South LaSalle street.

◆

The Hydro Transmission Corporation has been organized, with headquarters at Hamilton, Ohio, and officers as follows: Heinrich Schneider, president; J. E. Peterson, vice-president and treasurer; Adolph Schneider, vice-president; John B. Hollister, secretary. The company will handle engineering sales of an hydraulic transmission unit for Diesel switching locomotives and Diesel rail cars. The device will be manufactured under contract by the General Machinery Corporation, Hamilton, Ohio.

William H. Winterrowd, vice-president of the Franklin Railway Supply Company, has been elected vice-president in charge of operations of the Baldwin Locomotive Works, with headquarters at Eddystone, Pa., effective about February 15. Mr. Winterrowd graduated from Purdue University as a mechanical engineer in 1907. During college vacations he worked successively as a locomotive wiper, blacksmith helper and car repair helper. In 1907, upon graduation from college, he started as a special apprentice with the Lake Shore & Michigan Southern (now the Buffalo-Chicago section of the New York Central), where he served in the repair shops and enginehouses in various capacities until 1912 when he became assistant engineer in the mechanical department. Later in the same year, Mr. Winterrowd went to the Canadian Pacific as mechanical engineer. In 1915 he became assistant chief mechanical engineer and in 1918 chief mechanical officer of that road. In 1923 he joined the organization of the Lima Locomotive Works, Inc., as assistant to the president and, in 1927, he became vice-president of that company. Since 1934 he has been vice-president of the Franklin Railway Supply Company, Inc., an associated company of the Lima Locomotive Works, Inc. In 1936 Mr. Winterrowd received the degree of doctor of engineering from Purdue University. He is a director of the Purdue Research Foundation, and a member of the Mechanical Division, Association of American Railroads. He is also a member of a number of engineering societies.

W. H. Winterrowd

◆

The Bridgeport Safety Emery Wheel Company has authorized C. D. Hicks & Company to offer its equipment to the railroads in the southwestern territory.

◆

Neil C. Hurley, Jr., secretary of the Independent Pneumatic Tool Company, Chicago, has been elected vice-president. Mr. Hurley joined the company in 1932, upon graduation from the University of Notre Dame, and has been active in the direction of sales for the company's electric tool division.

◆

John E. Long has been appointed western sales manager of the Franklin Railway Supply Company, Inc., with headquarters in the McCormick building, Chicago. Mr. Long was graduated from Purdue University in 1923 with the degree of B. S. in mechanical engineering. Prior to his graduation he was employed in various capacities by the Pennsylvania, the Baltimore & Ohio, and the Atchison, Topeka & Santa Fe. In 1923 he entered the service of the Lima Locomotive Works, Incorporated, where he remained eleven years, during which time he was in the calculating, service, engineering and sales departments and had extensive experience in special design work and in locomotive testing. He also engaged in the study of operating conditions on various roads. In 1934, Mr. Long joined the Franklin Railway Supply Company, Inc., with headquarters at Chicago, where he has since been employed.

James H. Critchett, who has been in charge of research work, and Francis B. Morgan, who has been works manager of the Electro Metallurgical Company, a unit of Union Carbide and Carbon Corporation, New York, have been elected vice-presidents of the Electro Metallurgical Company.

◆

The Inland Steel Company, on January 3, completed a new blast furnace at its Indiana Harbor, Ind. plant. The furnace has a capacity of 1000 tons of pig iron, which will increase the company's productive capacity to more than 4,000 tons daily.

◆

The DeVilbiss Company, Toledo, Ohio, has announced training-school classes of one week each beginning March 13, April 17, May 15 and June 5. The school is open to industrial painters, master painters, automobile refinishers and others interested in learning the technique of spray-painting and the use and care of spray-painting equipment.

◆

Thomas Drever has been elected vice-president and treasurer of the American Steel Foundries, Chicago, succeeding George E. Scott, deceased. Mr. Drever was born in Edinburgh, Scotland, on May 2, 1882, and began his business career in that city in 1905 as a chartered accountant. In the same year he came to the United States and became an accountant in New York. From 1907 to 1910 he engaged in the same work at Boston, Mass. In the latter year he was appointed comptroller of the American Steel Foundries at Chicago, which position he held until 1924

Thomas Drever

when he was granted a leave of absence to become president of the Wahl Company. In 1929 Mr. Drever returned to the American Steel Foundries as secretary and treasurer. Later in that year he was a made a director and member of the executive committee. In 1932 he was elected vice-president and treasurer. Since 1929 he has been chairman of the board of the Wahl Company; vice-president and a director of the Griffin Wheel Company, Chicago, and a director and a member of the executive committee of the General Steel Castings Corporation, Eddystone, Pa.

The Universal Railway Devices Company, Chicago, has been incorporated in Delaware to take over and succeed to the business of the Universal Draft Gear Attachment Company, an Illinois corporation, with no change in the officers or personnel.

◆

James P. Raugh has been appointed general sales manager of the General Refractories Company, Philadelphia, Pa.

◆

Neil C. Hurley, Jr., has been elected a vice-president of the Independent Pneumatic Tool Company, Chicago.

◆

The United States Rubber Company, Mechanical Goods Division, Baltimore branch, which has heretofore functioned under supervision of the Philadelphia branch, will, in future, operate as an independent branch, under R. F. Jackson, as manager of mechanical sales. Frank M. Urban, assistant to W. T. Keenan, manager mechanical sales, Chicago branch, has been appointed assistant manager, mechanical sales, Chicago branch.

◆

The American Rolling Mill Company, Middletown, Ohio, has reorganized the home office of its Sheet and Strip Sales division. F. A. Tobitt, manager of enameling sheet sales, has been appointed manager of eastern sales, J. A. Ingwersen, manager of hot and cold rolled sales, has been appointed manager of midwestern sales, and G. W. Breiel, manager of galvanized and long terne sales, has been appointed manager of the southwestern sales.

Obituary

William P. Bradbury, vice-president and general sales manager of the Consolidated Ashcroft Hancock Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., died of pneumonia on Saturday, January 14.

◆

Forrest M. Titus, formerly sales engineer of the American Locomotive Company at Peiping, China, died on January 15 at Paterson, N. J. Mr. Titus was born on March 28, 1868, at Conneaut, Ohio. He was educated in the public high school of that city, and from 1890 until 1896 was, successively, an apprentice and a journeyman machinist in the employ of the New York, Chicago & St. Louis at Conneaut. He was shop foreman at Conneaut for the next five years, in 1901 becoming journeyman machinist in the service of the Union Pacific at Cheyenne, Wyoming. In 1902 he became a machinist in the employ of the American Locomotive Company at Pittsburgh, Pa., and some time later returned to the Nickel Plate at Conneaut. From 1904 until 1907 he was on the staff of the superintendent of motive power of the Union Pacific, in charge of shop efficiency work. He became general inspector of the American Locomotive Company, in charge of locomotive inspection work at their several plants, in 1907, and in 1910 was appointed foreign erecting engineer in charge of the installation of locomotives in Brazil. In 1912 he became assistant general superintendent of motive power of the Brazil Railways, in charge of the department of shops and motive power. In 1913 he was appointed general superintendent of motive power of the Brazil Railways, in full charge of the motive power department, with headquarters at Sao Paulo. The department was abolished at the outbreak of the World War, and in 1914 Mr. Titus went to Ichang, China, as superintendent of motive power, I-Kwei Section, Szechuen-Hankow Railway, act-

F. M. Titus

ing in an advisory capacity on the layout of shops, the selection of shop machinery, and on motive power and rolling stock. In the autumn of 1915 he became foreign erecting engineer of the American Locomotive Company, in charge of the installation of locomotives for the Trans-Siberian Railway at Harbin. From 1916 until 1933 he was sales engineer of the American Locomotive Company at Peiping, his territory including China, Japan, Korea and Formosa. He left the American Locomotive Company in 1934, and from 1935 until the outbreak of Japanese-Chinese hostilities in 1937 was mechanical engineer of the Nanking-Shanghai Railroad and advisor to the Chinese Ministry of Railroads.

◆

Charles A. Seley, consulting engineer of the Locomotive Firebox Company, Chicago, died in that city on January 19, of general debility. Mr. Seley was born at Wapella, Ill., on December 26, 1856, and entered railway service in 1879 as a draftsman for the St. Paul, Minneapolis & Manitoba, now part of the Great Northern. From 1881 to 1886, he engaged in other work of a mechanical engineering nature and in the latter year became chief draftsman for the St. Paul & Duluth, now part of the Northern Pacific. From 1888 to 1892, he was employed by the Great Northern. In the latter year he entered the railway supply business and after three years returned to railway service as chief draftsman for the Chicago Great Western. In April, 1899, he became mechanical engineer of the Norfolk & Western and in 1902 mechanical engineer of the Chicago, Rock

(*Continued on second left-hand page*)

Modern Equipment Needed To Reduce Expenses

The experience of recent years has indicated that, with increasing competition of other forms of transportation, the prospects of adding greatly to the gross revenues of the railroads are not particularly bright, surrounded with some uncertainty even with an improvement in general business conditions. For this reason, it is of great importance that every opportunity be grasped to effect permanent and substantial reductions in the cost of operation.

As far as the mechanical departments are concerned, they are directly responsible for the largest single item of operating expense—steam locomotive repairs—and, indirectly have considerable control over the fuel expense. These two items of operating expense, plus the expenditures for freight and passenger car repairs, amounted in 1937 to over 550 million dollars.

There are, therefore, two avenues open over which the mechanical officers have considerable control, the cost of locomotive operation and the cost of car and locomotive maintenance. With 67 per cent of the steam locomotives in this country over 20 years of age, it is well recognized that, as rapidly as funds can be found to finance their purchase, the introduction of modern motive power will contribute immeasurably to substantial reductions in the expense for fuel and maintenance.

In these days of small equipment replacement programs, the shop and engine terminal supervisor is working against odds in his battle to reduce maintenance costs for, if for no other reason, the increasing age of motive power brings about increases in the unit costs of repairs while, at the same time, a similar condition with respect to machine tools and shop equipment is making it more and more difficult to turn out repair work as economically and efficiently as it could and should be done with modern equipment. It is a case where the cost of repairs is automatically increasing because of a condition that can only be remedied by the modernization of equipment and repair facilities.

Whatever may be the ultimate outcome of the wage controversy, it does not alter the fact that the railways must save money.

It would seem, therefore, the railroad managements have arrived at a point where they must make a decision as to the future course to be followed in order to assure that their properties may remain solvent. Fortunately, with respect to both locomotive equipment and the facilities with which they are maintained, the records of performance of such equipment as has been installed in the last five or six years, proves conclusively that substantial reductions in operating and maintenance costs can be made.

Railway Mechanical Engineer
NOVEMBER, 1938

... COST
PERF

That
Reduce

RECORDS AND
RMANCE PROVE

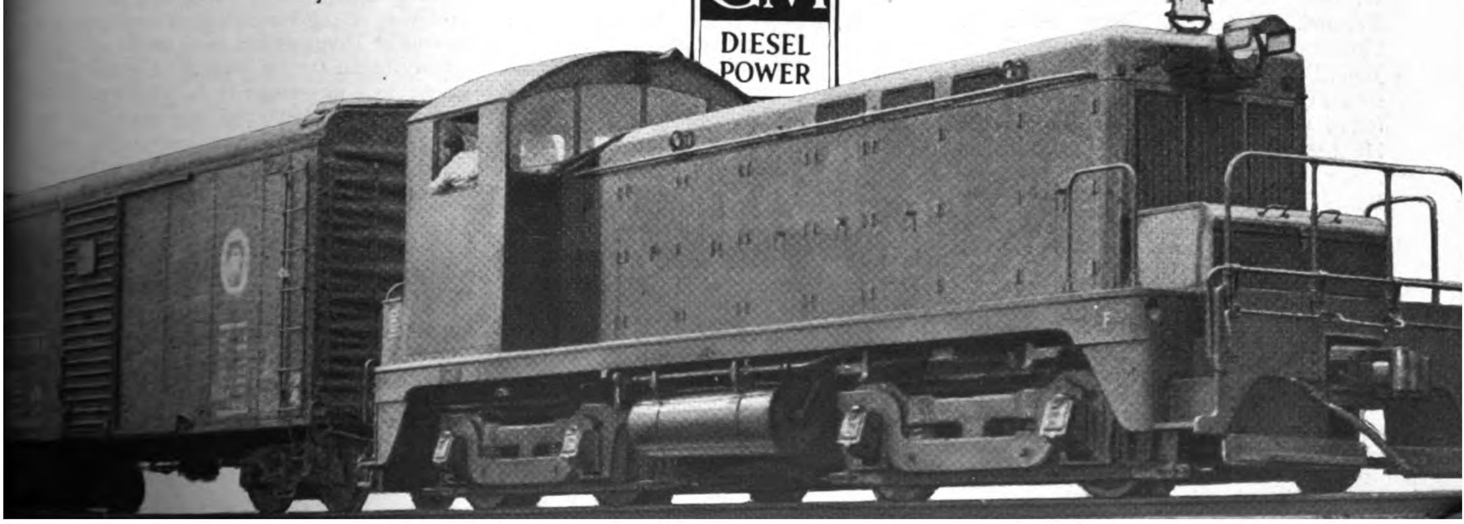
EMC Diesel Switchers
Operating Expenses 50%

RECORDS of over ONE MILLION service hours show that EMC Diesel operation has slashed fuel costs 75 per cent—maintenance costs 50 per cent and water costs eliminated entirely. Availability is averaging 94 per cent with records as high as 98 per cent. EMC switchers are saving more than $1,000.00 per month net over and above carrying and amortization charges. Potential economies also can be appraised from the fact that on one railroad 37 EMC Diesels have replaced 80 steam switchers.

Diesel Operation — The Greatest Advance in Modern Railroading.

ELECTRO-MOTIVE CORPORATION
SUBSIDIARY OF GENERAL MOTORS LA GRANGE, ILLINOIS, U. S A.

GM
DIESEL POWER



Island & Pacific at Chicago. On May 1, 1913, he again left railway service and became president of the American Flexible Staybolt Company, which company he helped to organize and with which he continued until its dissolution in 1921. In 1923, he became consulting engineer for the Locomotive Firebox Company. During his railway service he was a member of the executive committee of the Master

Charles A. Seley

Mechanics' Association for six years and of the Master Car Builders' Association for two years. He was a member of the subcommittee of the Association of American Railroads on the relation of railway operations to legislation in the matter of safety appliances, and wrote existing specifications for steel postal cars. He was president of the Western Railway Club during 1907-08.

◆

ALBERT E. BROWN, general manager of railroad sales of the Truscon Steel Company, with headquarters at New York, died in Chicago on January 5 of a lingering illness.

◆

FRED O. SMITH, vice-president of the Vulcan Iron Works, builder of locomotives, died suddenly at his home in Wilkes-Barre, Pa., on January 21. Mr. Smith was 62 years of age at the time of his death.

◆

FRANK NORTON HOFFSTOT, founder and former president of the Pressed Steel Car Company, Inc., Pittsburgh, Pa., who died on December 25, as reported in the January issue, was born on May 31, 1861, in Pittsburgh, where he became active in banking, real estate and the iron and steel industry. Mr. Hoffstot became interested in financing companies and, in 1898, Charles T. Schoen, president of the Schoen Pressed Steel Company, received from Mr. Hoffstot financial backing for his idea of building cars of steel. The Schoen Pressed Steel Company and the Fox Pressed Steel Company were consolidated to form the Pressed Steel Car Company, which was the first company to manufacture pressed steel cars. It was organized in 1899 with Mr. Schoen as president. In 1901 Mr. Hoffstot became president of the company, remaining in that capacity for 33 years. When the Pressed Steel Car Company went into receivership, Mr. Hoffstot became one of the three receivers, serving

Frank Norton Hoffstot

until the summer of 1934, when he retired and sold all of his interests in the company. Mr. Hoffstot was a metallurgist in addition to his other business interests.

◆

GEORGE E. SCOTT, president of the American Steel Foundries, Chicago, died on January 11, of a heart attack in Rochester, Minn., where he had gone for a throat operation.

Personal Mention

General

A. G. MUELLER, air brake instructor of the Chicago, Rock Island & Pacific, at Chicago, has been promoted to general mechanical inspector, with headquarters in the same city.

J. W. BAILEY, superintendent of motive-power shops of the Canadian National at Montreal, Que., has been appointed superintendent of motive-power shops at Stratford, Ont. Mr. Bailey was born February 15, 1885, in Liskeard Borough, Cornwall, England. He entered the service of the Canadian National at Fort Erie, Ont., on June 23, 1906, as a machinist in the local shops. On November 1, 1917, he was transferred to Lindsay as locomotive foreman. He became general foreman at Deering, Me., on November 1, 1922, and on October 10, 1930, was transferred to Montreal as night foreman at Longue Pointe. Four years later he went to Allandale, Ont., as locomotive foreman, and on May 1, 1935, returned to Montreal as general foreman. On March 1, 1937, he was appointed superintendent of the motive power shop at Montreal.

J. W. Bailey

O. K. WOODS, locomotive engineer on the Colorado division of the Union Pacific, has been appointed fuel engineer of the Eastern district, with headquarters at Omaha, Neb.

H. G. BAKER, road foreman of engines on the Idaho division of the Union Pacific, has been promoted to fuel engineer of the South-Central and Northwestern districts, with headquarters at Pocatello, Idaho.

C. P. BLAIR, assistant road foreman of engines of the Norfolk Division of the Norfolk & Western, has been appointed assistant trainmaster of the Shenandoah division.

W. C. SEALY, superintendent of motive-power shops of the Canadian National at Stratford, Ont., has been appointed superintendent of motive-power and car shops, with headquarters at Montreal, Que. The position of superintendent of motive-power shops at Montreal has been abolished. Mr. Sealy began service with the Canadian National as a messenger in the shops at Stratford in May, 1903, and one year later began his apprenticeship as a mechanic which was terminated in June, 1908. In November, 1909, he was appointed erecting shop foreman and in 1910 was transferred to Toronto, Ont., as general foreman. He was subsequently assistant master mechanic and master mechanic, the latter appointment being in November, 1915. During 1917 Mr. Sealy's services were loaned to the General Car and Machinery Company and he was employed at Montmagny, Que-

bec, instructing in the installation of a shell-manufacturing plant. He returned to Stratford in September, 1917, as foreman during a period when that shop was also engaged in the manufacture of shell for the British Army. In 1921 Mr. Sealy became general foreman at Stratford and in October, 1928, was appointed acting superintendent of the motive-power shop there, being confirmed as superintendent of the motive-power shop in January, 1929.

W. C. Sealy

Master Mechanics and Road Foremen

J. L. Cato, master mechanic on the Southern Pacific Lines in Texas and Louisiana, with headquarters at El Paso, Tex., retired on January 1, and the position of master mechanic at El Paso has been abolished.

Arthur H. Fiedler, road foreman of engines on the Northern Pacific, with headquarters at Livingston, Mont., has been promoted to master mechanic of the Fargo division, with headquarters at Jamestown, N. D.

L. J. Gallagher, master mechanic of the Fargo division of the Northern Pacific has been transferred to Parkwater, Wash.

Car Department

G. McLennan, superintendent of car shops of the Canadian National at Montreal, Que., has retired. The position of superintendent of car shops at Montreal has been abolished. Mr. McLennan was born on November 22, 1879, and began railway service as coach carpenter in the car department of the Canadian National at Montreal in 1907. After many years of service at Montreal he also served at Toronto and Ottawa, being transferred back to Montreal in 1928 as superintendent of car shops.

W. G. Palmer, freight-car-shop foreman of the Canadian National at Montreal, Que., has been appointed general foreman of the car shops at Montreal, Que.

George Steuber, shop superintendent of Despatch Shops, Inc., has been promoted to assistant to the vice-president and general manager and shop superintendent.

Shop and Enginehouse

Marshall Hogan, machinist on the Pere Marquette at St. Thomas, Ont., has been promoted to the position of enginehouse foreman, with headquarters at Chatham, Ont.

Percy W. McNevin has been appointed acting general foreman on the Canadian National at Charlottetown, Prince Edward Island, succeeding J. A. Miller, retired.

Winsby Walker has been appointed general foreman of the motive-power shops of the Canadian National at Montreal, Que.

Purchasing and Stores

K. L. Brenner, assistant purchasing agent on the Wabash, at St. Louis, Mo., has been appointed acting purchasing agent at that point, succeeding to the duties of T. J. Frier, who has been granted a leave of absence on account of ill health.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Threading Equipment.—Landis Machine Company, Inc., Waynesboro, Pa. Booklet illustrating and briefly describing Landis threading machines, die heads, taps, etc.

◆

Washers.—Wrought Washer Mfg. Co., 2100 S. Bay street, Milwaukee, Wis. Stock list No. 55-B. Lists washer specifications in various materials, including steel, brass, copper, aluminum, fibre, etc.

◆

Safety-Pull.—Coffing Hoist Co., Danville, Ill., 12-page catalog No. S4. Safety-Pull ratchet lever hoists and load binders.

◆

Drill Pointer.—Oliver Instrument Co., Adrian, Mich. Seven-page booklet. General description and specifications for the new Oliver of Adrian drill pointer.

◆

Thermit Welding; Murex Electrodes.—Metal & Thermit Corporation, 120 Broadway, New York. The Thermit welding process and its applications are described and illustrated in a 34-page booklet; the physical properties and chemical analysis of the weld deposited by each of 20 odd electrodes in the Murex line, in a new edition of the pocket-size pamphlet on Murex welding rods.

Copper and Copper Alloys.—Revere Copper and Brass, Incorporated, 230 Park avenue, New York. Four-page reprint containing a brief summary of the important properties and typical industrial applications of thirty representative coppers and copper-base alloys discussed in a paper by M. G. Steele, technical advisor of the Baltimore division of the company before the Baltimore Purchasing Agents Association, November, 1937. Important properties of the coppers and copper-base alloys and forms in which each is commercially supplied, as well as uses and methods of fabrication, are charted in tabular form.

◆

Pneumatic Riveters.—Hannifin Manufacturing Company, Chicago. Bulletin No. 43; 12-pages. Describes a recent development in Allen-type portable and stationary pneumatic riveters. Furnishes comprehensive information concerning the construction, capacities and operating advantages of pneumatic riveting machines and gives information regarding Hannifin hydraulic riveters, also pneumatic and hydraulic equipment for use in various production operations.

◆

Molybdenum In Steel.—Climax Molybdenum Company, 500 Fifth avenue, New York. A 12-section, loose-leaf compilation of useful data on all types of molybdenum steels, both wrought and cast, steel for elevated-temperature-service, corrosion-resisting steels, and cast steels. Comprehensively indexed.

◆

Do-All Machine.—Continental Machine Specialties, Inc., Minneapolis, Minn. 1301-7 Washington Avenue S. Illustrated folder giving information on filing and sawing speeds for more than 48 materials and other data on selection and use of cutting tools employed for contour machining.

◆

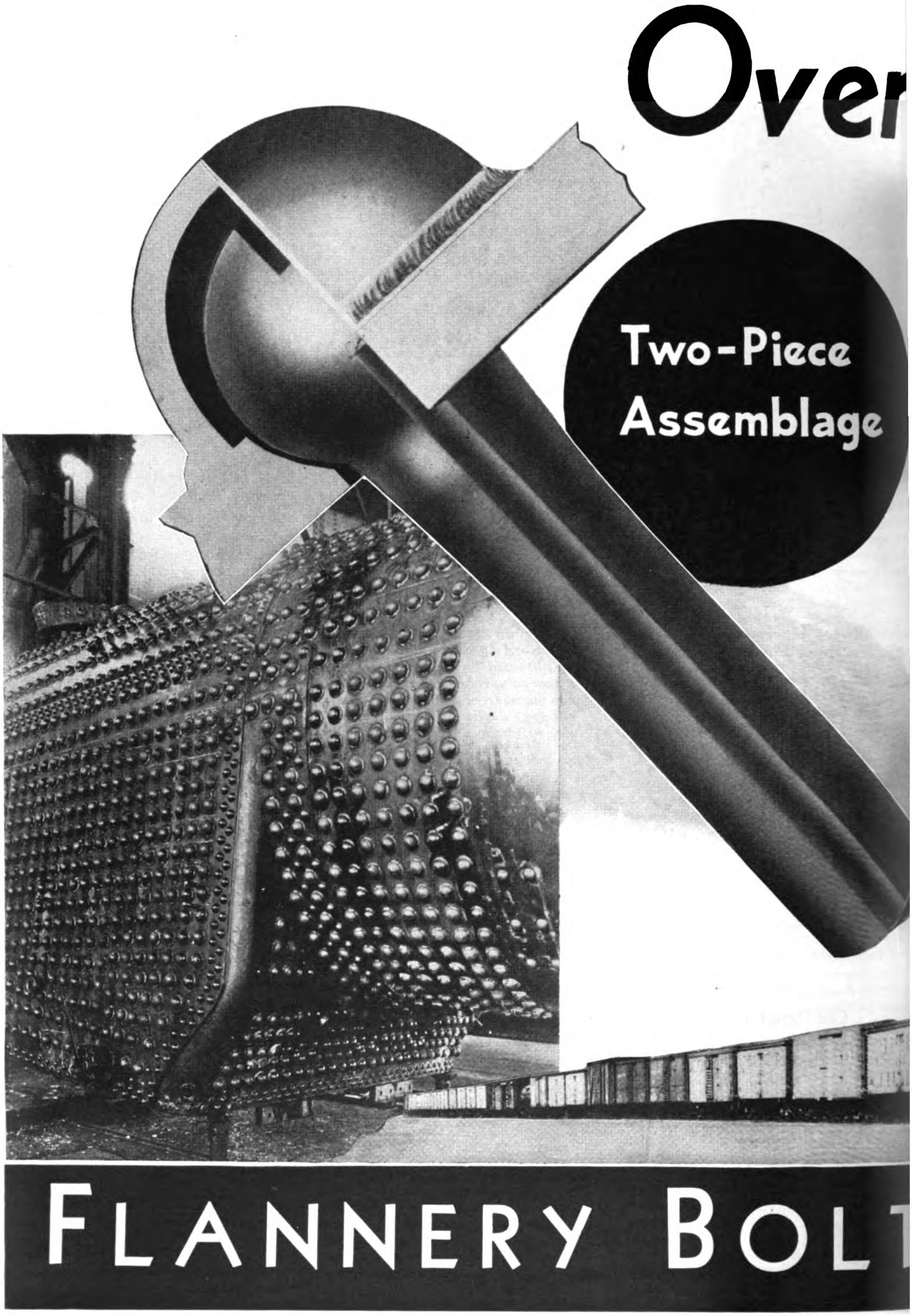
Grey Iron Castings.—The International Nickel Company, Inc., 67 Wall street, New York. Revised data sheet, Section 1, No. 1. Guide to the selection of engineering specifications for grey cast iron, with special reference to sections of various dimensions and tensile strengths of 20,000 to 60,000 lb. per sq. in.

◆

Valves.—Homestead Valve Mfg. Co., Coraopolis, Pa. Reference Book No. 38; 48 pages, illustrated. Features blow-off valves; lift-plug valves, dimensions, tables and facts about Homestead valves, and a new line of semi-steel 500-lb. (oil, water, gas) valves for the oil industry.

◆

Truck Casters and Wheels.—The Fairbanks Company, 393-399 Lafayette street, New York. Catalog 53-44. Standard designs of casters and wheels used by industrial plants, transportation companies, contractors, etc.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Founded in 1832 as the American Rail-Road Journal

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See page 85.

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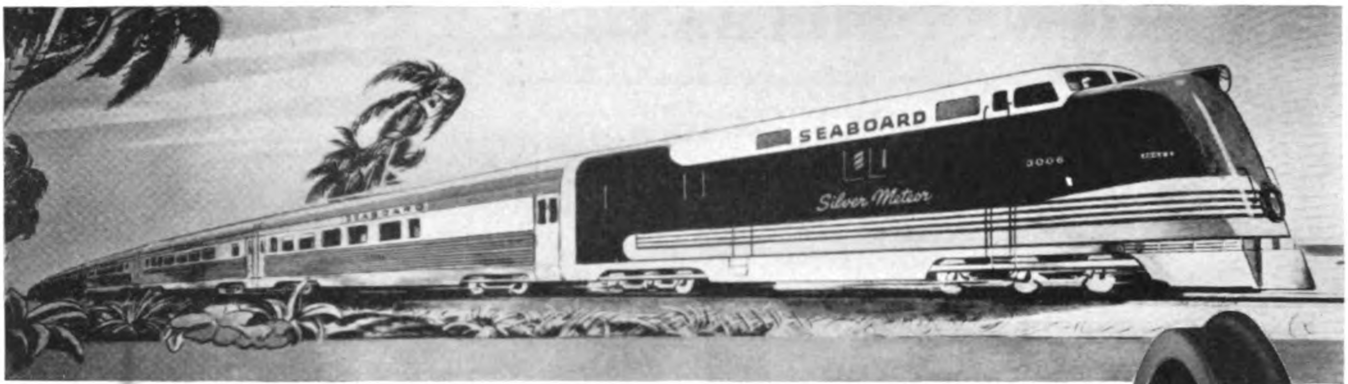

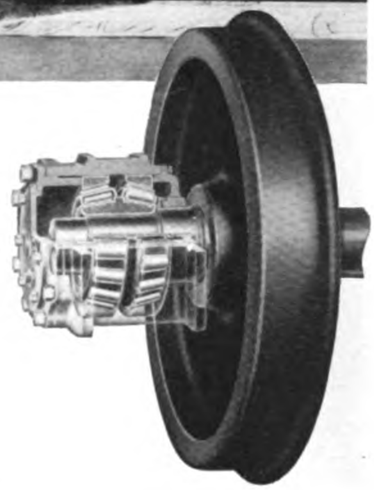

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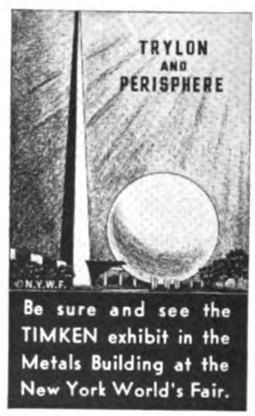

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Results and Conclusions of

Locomotive Slipping Tests*

By
T. V. Buckwalter†
and
O. J. Horger‡

Tests on three roads, using high-speed motion photography, show graphic record of forced build-up of unbalanced rotating forces until the main drivers leave the rails

THE demands for higher speed in railroad transportation in both freight and passenger service, particularly the latter, has raised new problems in connection with the maximum permissible speeds for steam locomotives.

Passenger schedule speeds previous to the advent of the streamliners were satisfactorily negotiated at diameter speeds. Train schedules have been shortened in the last few years, requiring locomotive operation at speeds much higher than diameter speeds. These faster schedules have involved locomotive speeds approaching and in some cases exceeding the top safe operating speeds for conventional steam locomotives from the standpoint of the danger of causing rail damage. Concurrent with the high operating speeds has been the demand for more powerful locomotives, particularly in the upper speed range, and these two requirements have accentuated the dynamic forces on the rail resulting principally from counterbalancing conditions.

This subject of rail damage was brought forcibly to our attention with the introduction in service of the New Haven 4-6-4 passenger locomotives in 1937. It was thought in some quarters that rail damage developing on this road might be due to some extent to the introduction of roller bearings on drivers which was new at that time on this road. After considerable discussion among ourselves, W. C. Sanders, manager railroad division, suggested to the New Haven that a definite slipping test be made on greased track to produce high rotative speed of the drivers so that the test could be viewed over a selected piece of track by railroad men and other interested observers.

Such slipping tests were made on the New Haven and later on the New York Central and Santa Fe.

New Haven Tests

Slipping tests were made with two 4-6-4 locomotives, one having plain-bearing driving axles (I4 class) and the other locomotive having roller-bearing drivers (I5 class). The first series of tests on both locomotives did not produce rail damage which was explained by insufficient slipping speed of the plain-bearing engine and not leaving the throttle open for sufficient time beyond the greased section on the roller-bearing locomotive, even though the maximum slipping speed was calculated to be 121 m. p. h. Several later tests were made, however, where rail damage was sufficient to require rail replacement. In such tests the train speed was about 55 m. p. h. and maximum slipping speed about 114 m. p. h. As a result of these tests the overbalance on the main pair of wheels of this class of locomotive was reduced from about 200 to 100 lb., and we understand that such

Table I — Slipping Tests Made on C. B. & Q. Locomotives

Kind of locomotive tested			Driving-wheel diameter, in.	Test speed, m.p.h.		Length of greased section, ft.	Dynamic augment, main driver*	
Number	Type	Class		Train speed	Max. slip speed		Diameter speed, lb.	Max. slip speed, lb.
3012	S-4	4-6-4	78	56	98	230	14,111	27,053
				66	108	230	21,600	41,400
3001	S-4-A	4-6-4	78	47	88	230		
				67	98	230	14,111	23,193
				70	100	230	21,600	35,500
4003	S-4-A	4-6-4	78	72	112	300		
				78	123	300	4,596	12,377
				81	128	504	8,480	22,800
6314	M-4-A	2-10-4	64	51	80	504	11,315	17,680
				53	80	230	15,430	24,100
5604	O-5	4-8-4	74	67	93	230		
				74	102	230	6,000	11,850
				80	104	230	12,930	25,570
5623	O-5-A	4-8-4	74	78	111	300	5,520	13,330
				80	115	300	11,500	27,700

*The first value given is calculated using conventional overbalance in counterbalance plane and second value is actual dynamic augment in plane of rail; the difference being the error in using the conventional overbalance weight and differences in planes. See Table III and text for explanation.

* Part I of the abstract of a paper presented before the New York Railroad Club, February 17, 1939, in connection with motion pictures.
† Vice president, Timken Roller Bearing Company, Canton, Ohio.
‡ Research engineer, Timken Roller Bearing Company.

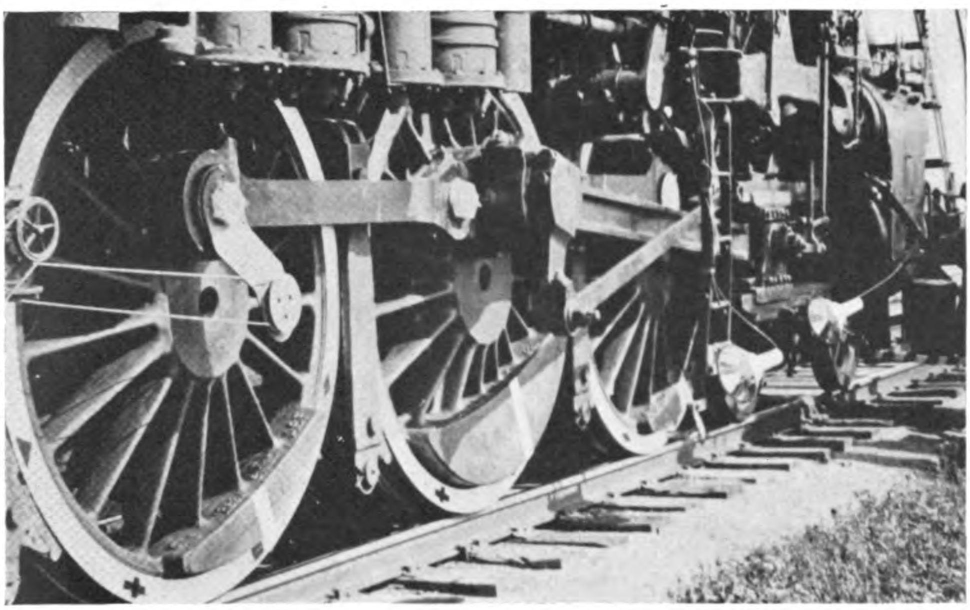


Fig. 1—Running gear of one of the C. B. & Q. 4-6-4 type locomotives, showing the markings on the wheels, speed indicator drive, and photographic lighting equipment. The camera is shown in Fig. 10. This locomotive has conventional rods and crossheads

modification has corrected their difficulties with rail damage.

New York Central Tests

The New York Central introduced the J3A, 4-6-4, Hudson type locomotive in 1937, and slipping tests were made on the main line track to determine the speed at which rail damage would be produced with an overbalance of 100 lb. in the main wheel. These tests were made in April, 1938, involving four slipping tests at train speeds of 61 to 82 m. p. h. and with maximum slipping speeds from 123 to 164 m. p. h. The three locomotive tests up to 135 m. p. h. left some question as to whether the wheels lifted off the rail because of difficulty in following the locomotive with the cameras and the clarity of the pictures, but no rail damage developed. In the test at 164 m. p. h. the drivers definitely left the rail but no track damage developed of sufficient importance to necessitate removal of rail.

The New York Central slipping speeds were considerably higher than the New Haven and indicated that the lightweight reciprocating parts, reduced dynamic augment, lower unbalanced reciprocating weights, and heavy rail had a distinctly favorable modifying influence on high-speed locomotive operation. No modification was made in the balancing of these locomotives as a result of these tests.

Santa Fe Tests

The Santa Fe railroad made high-speed slipping tests on one of its new 4-8-4 locomotives at Albuquerque, N. M., in June, 1938. This is a much heavier locomotive than those previously tested, having a weight of reciprocating parts in proportion to its power. Slipping tests made on yard track resulted in considerable rail damage at about 97 m. p. h., but it should be mentioned that this track constituted worn rail removed from main-line service and the ballast did not represent main line conditions. These locomotives are equipped with roller bearings throughout and are used in hauling the fast Santa Fe trains over the mountain district of 1,200 miles between La Junta, Colo., and Los Angeles, Calif. Further tests were being made with this class of locomotive to determine track and bridge stresses but we are not familiar with any final changes that were made relative to counterbalancing.

Conclusions From Above Tests

It was apparent from these tests that the photographic method used was inadequate for detailed analysis of the action of the main driving wheels on the rail. The slipping tests made on the above three roads were photographed with 16 mm. cameras mounted on tripods and located on the ground. Even though telephoto lenses were used considerable difficulty was experienced in holding the driver-rail contact in the field of view while following the locomotive with the camera as it passed the observer.

These moving pictures, notwithstanding the technical difficulties of photography, developed interesting informa-

Table II — Data for Six C. B. & Q. Locomotives Used in Slipping Test

Locomotive class	S-4	S-4-A	S-4-A	O-5	O-5-A	M-4-A
Road number	3012	3001	4003	5604	5623	6314
Type of locomotive	4-6-4	4-6-4	4-6-4	4-8-4	4-8-4	2-10-4
Builder	C. B. & Q., 1935	Baldwin, 1930	Baldwin, 1930	Baldwin, 1930	C. B. & Q., 1938	Baldwin, 1927
Rebuilt	Plain-bearing drivers and reciprocating parts	Timken driver bearings, equipped 1938	Timken rods and reciprocating parts and driver bearings, equipped 1938	Plain-bearing drivers and reciprocating parts	Timken reciprocating parts and driver bearings, when built	Timken driver bearings, equipped 1938
Cylinder size, in.	25 x 28	25 x 28	25 x 28	28 x 30	28 x 30	28 x 32
Boiler pressure, lb. per sq in.	250	250	250	250	250	250
Driver diameter, in.	78	78	78	74	74	64
Tractive force, lb.	47,700	47,700	47,700	67,500	67,500	83,300
Weight on drivers, lb.	207,730	212,650	209,310	274,000	275,500	338,400
Weights of reciprocating parts, lb. (per side):						
Main rod	429	429	249	502	317	379
Crosshead, etc.	440	440	258	1,028	384	1,150
Crosshead shoes	352	352	114	402	141	391
Union link	32	32	26	32	28	32
Piston, etc.	856	856	379	516	508	501
Total	2,109	2,109	1,026	2,480	1,378	2,453

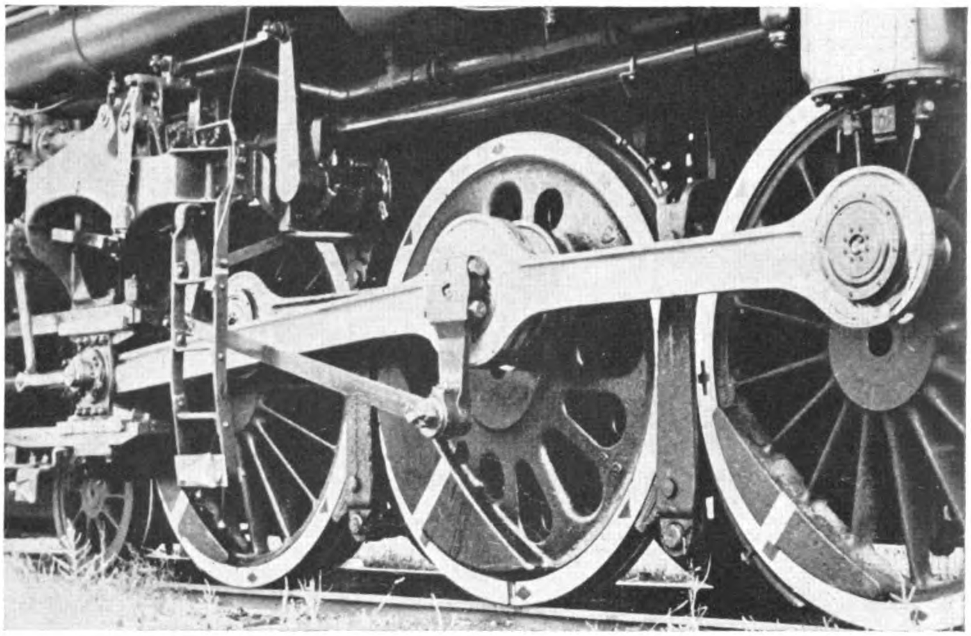
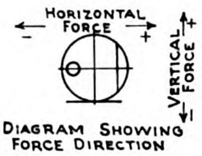


Fig. 2—Another one of the Burlington 4-6-4 type locomotives which has been equipped with roller bearings on the driving axles, lightweight reciprocating parts and roller bearing rods

Table III — Counterbalance Record on Six C. B. & Q. Locomotives Used In Slipping Tests



Locomotive class	S-4	S-4-A	S-4-A	O-5	O-5-A	M-4-A	M-4-A
Road number	3012	3001	4003	5604	5623	6314	Not tested
Type of locomotive	4-6-4	4-6-4	4-6-4	4-8-4	4-8-4	2-10-4	2-10-4
Front Driver:							
Static balance, lb.	+245	+245	+103	+243	+ 95	+172	+72
Crossbalance* (plane of rail)							
Horizontal component, lb.	+219	+219	+ 68	+229	+ 78	+166	+62
Vertical component, lb.	+ 26	+ 26	+ 34	+ 14	+ 16	+ 6	+10
Resultant, lb. and angle	221 at 6 deg. 46 min.	221 at 6 deg. 46 min.	76 at 26 deg. 34 min.	229 at 3 deg. 30 min.	80 at 11 deg. 36 min.	166 at 2 deg. 1 min.	63 at 9 deg 10 min.
Front Intermediate Driver:							
Static balance, lb.	....	....	....	....	....	+172	+72
Crossbalance* (plane of rail)							
Horizontal component, lb.	....	....	....	....	....	+137	+33
Vertical component, lb.	....	....	....	....	....	+ 35	+39
Resultant, lb. and angle	....	....	....	....	....	141 at 14 deg. 20 min.	51 at 49 deg. 46 min.
Main Driver Crossbalance:							
A.A.R. method, lb.	+315**	+315**	+103	+125	+115	+175	+51
Same with correction on back end of main rod—per method of Henderson (plane of rail)							
Horizontal component, lb.	+478	+478	+188	+266	+236	+298	+75
Vertical component, lb.	— 47	— 47	— 21	— 35	— 30	— 35	— 3
Resultant, lb. and angle	481 at 5 deg. 37 min.	481 at 5 deg. 37 min.	189 at 6 deg. 22 min.	268 at 7 deg. 30 min.	238 at 7 deg. 15 min.	301 at 6 deg. 42 min.	75 at 2 deg. 26 min.
Back Intermediate Driver:							
Static balance, lb.	....	....	....	+353	+115	+221	+72
Crossbalance* (plane of rail)							
Horizontal component, lb.	....	....	....	+271	+ 41	+192	+36
Vertical component, lb.	....	....	....	+ 82	+ 74	+ 28	+36
Resultant, lb. and angle	....	....	....	283 at 16 deg. 49 min.	87 at 61 deg. 0 min.	194 at 8 deg. 18 min.	51 at 45 deg. 0 min.
Back Driver:							
Static balance, lb.	+245	+245	+103	+243	+ 95	+172	+72
Crossbalance* (plane of rail)							
Horizontal component, lb.	+217	+217	+ 5	+225	+ 77	+161	+56
Vertical component, lb.	+ 28	+ 28	+ 98	+ 19	+ 19	+ 11	+16
Resultant, lb. and angle	219 at 7 deg. 21 min.	219 at 7 deg. 21 min.	98 at 87 deg. 5 min.	225 at 4 deg. 42 min.	79 at 13 deg. 52 min.	161 at 3 deg. 55 min.	58 at 16 deg. 26 min.

*All main wheels cross counterbalance and other than main statically balanced—weights in pounds.
**2/3 of eccentric crank weight is used here whereas ½ is used on all other values given.

tion which proved of value to the respective roads. The pictures showed that the main pair of driving wheels was leaving the rail and in addition had a see-saw action across the track. In some of these slipping tests, the crank pin was in the up and others in the down position with respect to the rail when the wheel was off the track. Such lifting of the wheel from the rail could not be explained by conventional methods of analysis where the inertia forces of the counterbalance were considered. That is to say, that the driving wheel was calculated to begin to leave the rail when the speed was sufficient to develop an inertia from the overbalance equal to the weight on the wheel. In these tests, however, the wheel left the rail much earlier than would be anticipated from such calculations.

At that time it was our belief that this lifting of the main wheels was due to forced vibrations, but this could not be confirmed because of insufficient test data. These forced vibrations were believed to have developed principally from the overbalance to cause the unsprung mass of the driving axle assembly to vibrate and lift off of the track structure which acted as an elastic foundation. This explanation seemed reasonable in view of being able to demonstrate such action by laboratory models and mathematical analysis. Introduction of forced vibrations was new in that driver speeds of sufficient value had not

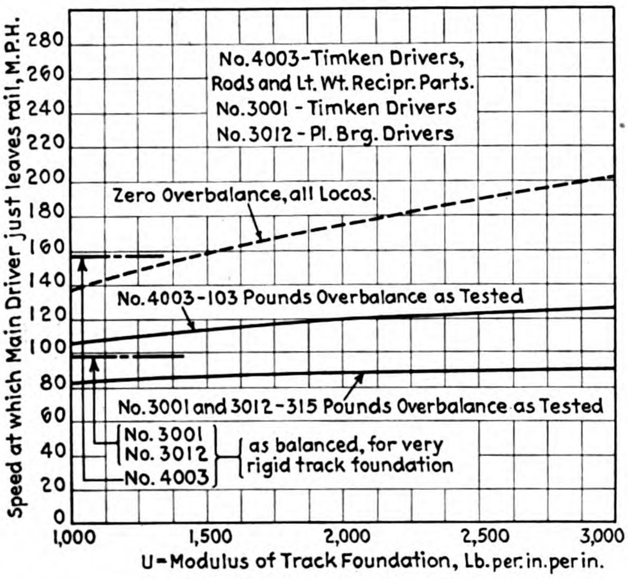


Fig. 3—Comparison of calculated speeds at which the main driver leaves the rail

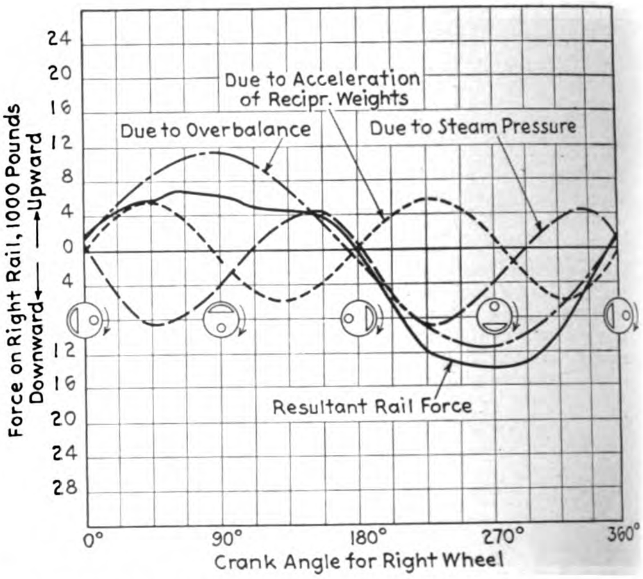


Fig. 6—Dynamic rail force under main drivers, locomotive 4003 with Timken drivers, rods and light weight reciprocating parts

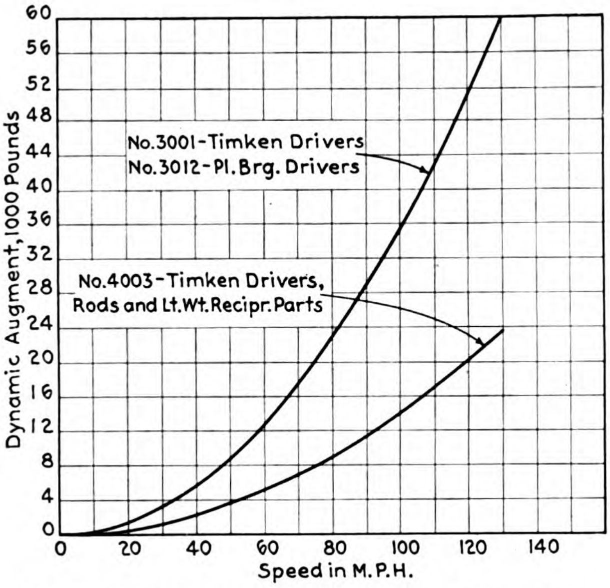


Fig. 4—Comparison of dynamic augment on 4-6-4 main drivers

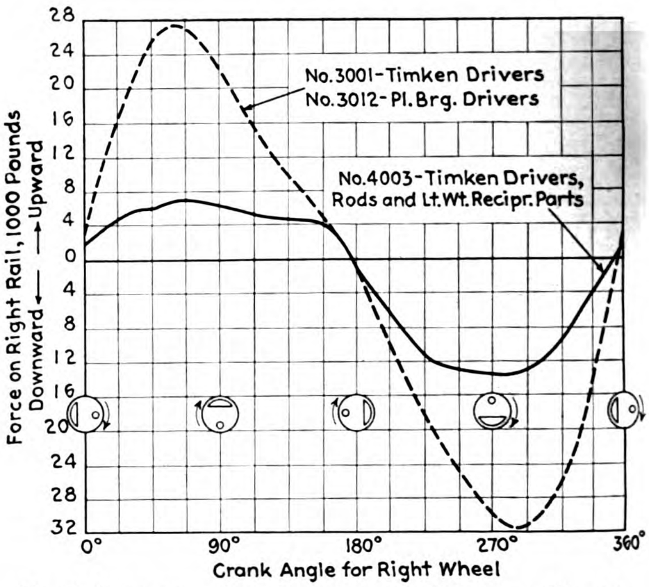


Fig. 7—Comparison of resultant dynamic rail force at 90 m.p.h.

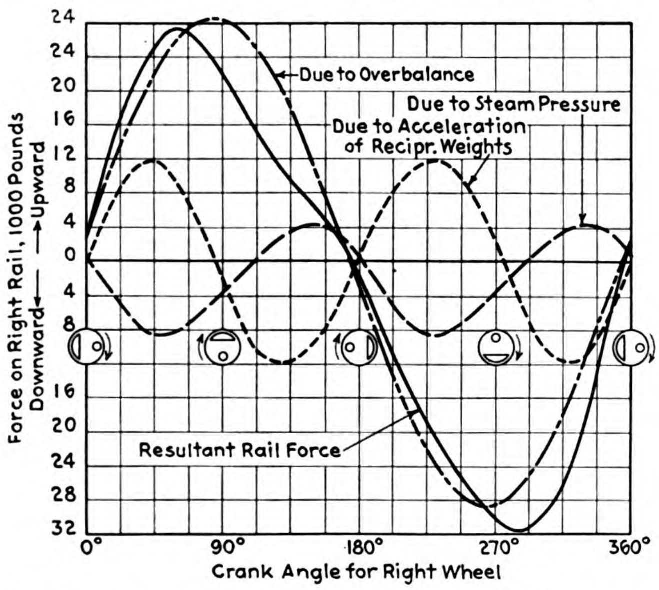


Fig. 5—Dynamic rail force, main drivers, locomotives 3001 and 3012 at 90 m.p.h.

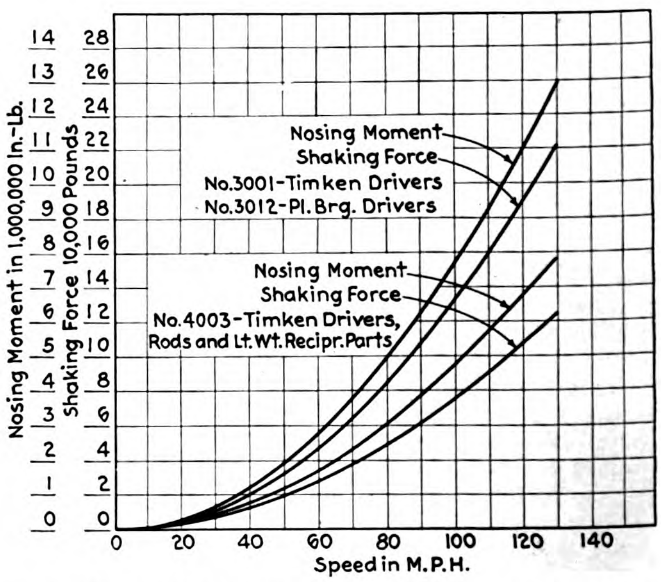


Fig. 8—Comparison of nosing moment and shaking forces (fore and aft)

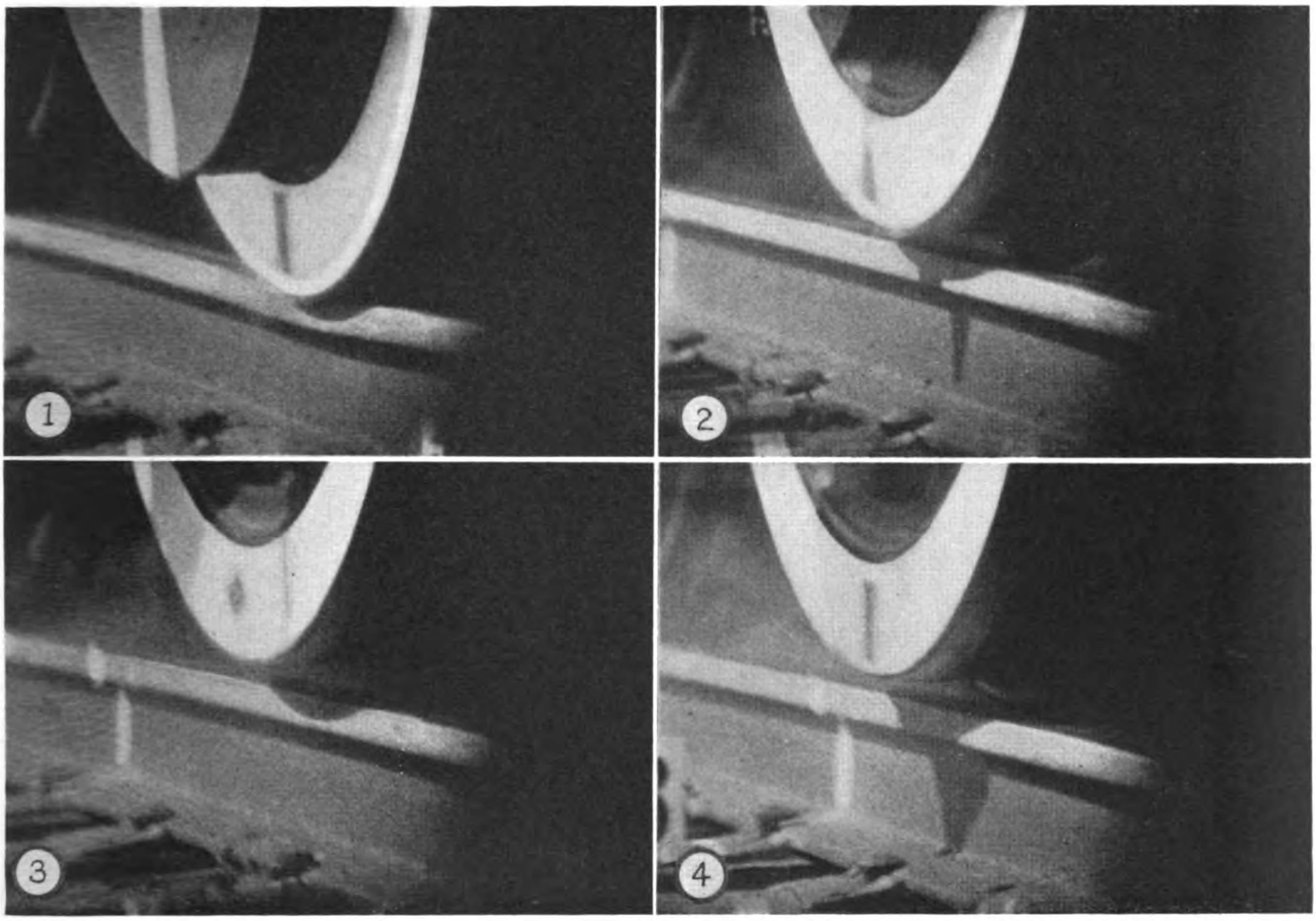


Fig. 9—Enlargements made from 16-mm. movie film taken at 400 frames per second (25 times normal speed)

Burlington 4-6-4 type locomotive No. 3012 equipped with plain bearing driving axles and having 2,109 lb. weight of reciprocating parts per side with 315 lb. overbalance. The white vertical line on the counterbalance is diametrically opposite the main crankpin and does not indicate the center of gravity of the balance. In the above pictures the position of the balance is given with reference to the vertical line to the rail and the white line. Picture No. 1 shows the counterbalance down and the crankpin up; No. 2, counterbalance 90 deg. from vertical; No. 3, counterbalance 45 deg. from top vertical, and No. 4, crankpin down and counterbalance on top vertical

Table IV — Weight Per Axle, in Lb., on Six C. B. & Q. Locomotives Used in Slipping Test

Class	S-4	S-4-A	S-4-A	O-5	O-5-A	M-4-A
Road number	3012	3001	4003	5604	5623	6314
Type of locomotive	4-6-4	4-6-4	4-6-4	4-8-4	4-8-4	2-10-4
Front:						
Sprung	53,600	53,600	53,250	54,740	53,985	51,623
Unsprung	15,400	16,900	16,740	14,100	15,414	13,780
Total	69,000	70,500	69,990	68,840	69,399	65,404
Front intermediate:						
Sprung	....	....	....	....	....	50,364
Unsprung	....	....	....	....	....	15,370
Total	....	....	....	....	....	65,734
Main:						
Sprung	47,800	47,800	47,550	44,477	43,862	45,575
Unsprung	21,980	23,680	21,640	23,550	23,954	23,980
Total	69,780	71,480	69,190	68,027	67,816	69,555
Back intermediate:						
Sprung	....	....	....	52,869	52,138	53,323
Unsprung	....	....	....	15,510	16,784	16,450
Total	....	....	....	68,379	68,922	69,773
Back:						
Sprung	53,600	53,600	53,400	54,724	53,968	53,778
Unsprung	15,350	16,850	16,730	14,120	15,418	13,675
Total	68,950	70,450	70,130	68,844	69,386	67,453

been so generally experienced in operation in the past.

With this background of experience on these earlier slipping tests more extensive tests were planned on the Burlington which will now be discussed.

Burlington Slipping Tests

The Burlington requested our co-operation in determining the speeds at which rail damage may occur with several classes of road locomotives so that a safe road speed could be established. H. H. Urback, mechanical assistant to the executive vice-president, placed the technical direction of the picture study in our hands. The program involved the testing of six locomotives, as follows: three 4-6-4 passenger locomotives, two 4-8-4 passenger and freight locomotives, one 2-10-4 freight locomotive.

A record of the tests made is shown in Table I while Table II gives the physical characteristics of the locomotives and the weight of the reciprocating parts. The counterbalance statement is shown in Table III. The sprung and unsprung weights on driving axles are indicated in Table IV.

Location of Tests

The test track selected was a straight section for 5½ miles and was located on the main line from Chicago

to Omaha, Neb., between Plano, Ill., and Bristol, about 10 miles west of Aurora. The rail was 100 lb. RA rail laid on chat (lead ore) ballast. The test section was located on a fill varying from about 6 to 12 ft. deep.

Preparation for Test

Station number plates from No 0 to 50 were located on the ends of ties on about 12 ft. spacing on both the left and rights sides of the track for a distance of 616 ft. This was done so that the moving picture showing the action of the wheel on the rail could be identified with the location of any track damage. After the first locomotive test, it was found necessary to extend the length of the marked section about 300 ft. inasmuch as some track damage occurred beyond the 616 ft. length.

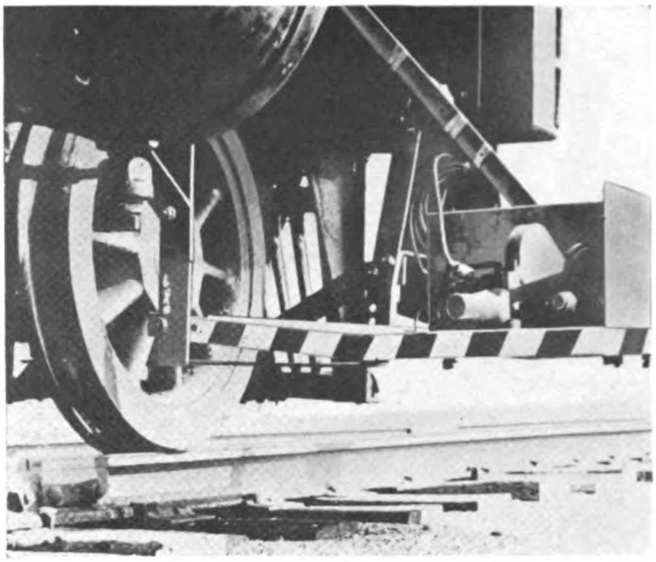


Fig. 10—Camera equipment on platform

The heads of both rails were greased with a rail flange graphite grease starting at station number 0 and extending for about seven rail lengths or 231 ft., which adjoined station 19. This length of greased section was increased in several tests to 300 ft. and 504 ft. as indicated in Table I.

Deflection gages were located between each tie from stations 31 to 34 to indicate maximum rail deflection. Additional gages were located on each tie between stations 44 and 45 to indicate rail and tie deflection, and such measurements were recorded by a moving picture camera. It developed that these gages were not located sufficient distance from the greased section to be in a region where the wheels did the most lifting from the rail.

The speed of the train was determined from gages located in the dynamometer car and locomotive cab. The slipping speed of the driving wheels was obtained electrically by means of a Weston generator drive connected to the rear driving wheels.

An indicating lever device was located on the side of each locomotive to show throttle operation. Its operation was in the field of view of the camera and a pictorial record of throttle operation with reference to location on test track was recorded in the moving pictures. An L-shaped lever was attached to the lower steps and the throttle is open when the lower leg of the lever is in the up position and closed with the leg down.

All driving-wheel tires were painted white and distinguishing black marks applied at 45 deg. intervals around the tires. A white line was painted on the counterbalance diametrically opposite the crank pin. The end of the crank pin was also painted white. This marking provided a reliably accurate means of observing the movement of the wheels on the rail.

Camera Equipment

The outstanding difference on the Burlington tests as distinguished from the three previous tests was in the selection and mounting of the camera equipment and taking pictures from both sides of the locomotive so that the wheel action on both sides of the locomotive could be correlated. In these tests it was decided to mount the cameras on folding platforms attached to the locomotive just ahead of the cylinders and about one foot above the

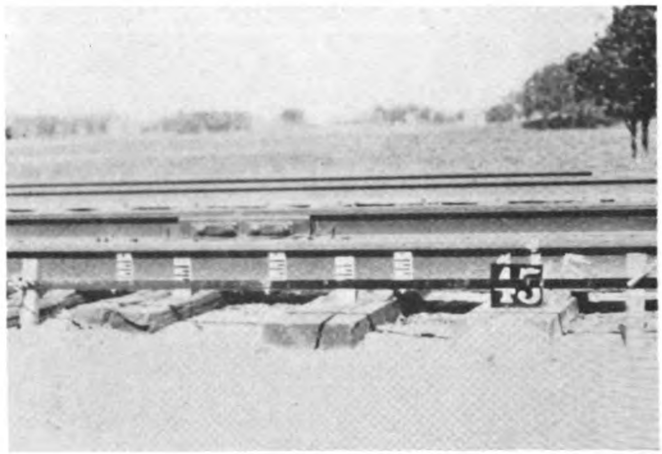


Fig. 11—Rail and tie deflection gages

rail. The camera equipment was furnished through the courtesy of the Eastman Kodak Company and consisted of two 100-frame per second motor-driven cameras, one being located on each side of the locomotive. In addition a third camera operating at ultra high speed of 400 frames per second was mounted on the right side. Normal picture speed is 16 frames per second so that the action of the wheels is produced in slow motion in the ratio of 6 to 1 and 25 to 1, thereby permitting a detailed study of driver movement with respect to the rails.

Consist of Test Train

A total of five or six steel cars were used on all tests, consisting of one baggage, one dynamometer, and three to four passenger coach cars.

Test Procedure

The test train approached the greased section at a uniform speed as given in Table I. The throttle was left open beyond the end of the greased section for sufficient time to bring the slipping speed up to near the desired value which occurred in many tests at about station 70, or about 800 ft. beyond the beginning of the greased section. It is essential that the throttle be left open long enough for vibrations to build up. Vibrations dampen out at a fast rate after closing the throttle.

Modulus of Track Foundation

Determination of the value of modulus of elasticity of the track support was made over a length of track where the driving wheels lifted off the rail. This modulus was computed from measurements made at 47 tie locations using a loaded truck. Two different truck weights were used where the wheel loads were 5,150 lb. and 17,400

(*Continued on page 104*)

Serviceability of

Heavy-Duty Piston Rods

By H. G. Miller* and L. E. Grant†

Heat-treated carbon-steel rods show up well in competition with alloy-steel rods in extensive tests

EARLY in 1930 the Chicago, Milwaukee, St. Paul & Pacific took delivery of the first of 14 new high-speed, Class F6, 4-6-4 type locomotives, for heavy passenger-train service. Seven months later a piston rod on one of these engines failed by breaking at the crosshead fit and this was but the first of many similar failures. At one time more than 30 cracked and broken piston rods had been collected at the test department for inspection and analysis. It was soon obvious that something would have to be done about piston rods if these locomotives were to be kept in successful operation. A rather comprehensive test was planned, provisions being made to obtain records of mileage and other pertinent information for each piston rod.

Various kinds of steel were tried to see if one could be found that would give satisfactory service. Changes in the design and size of the rods were also made in an effort to improve the performance. The information that was developed during a period of about six years of such testing is interesting and it is believed that an account of it may be of some value to other railroad men. Piston-rod failures are a common difficulty and, if one can judge from the number of letters published in *Railway Mechanical Engineer,* piston rods are a live topic for discussion in many locomotive shops and roundhouses.

Stress in Piston Rods

The crossheads used on the engines referred to are the Laird-type, shown in Fig. 1. The center of gravity of the crosshead is 5.6 in. above the center line of the piston rod and this produces an unbalanced load on the rod. The assembled crosshead now in use weighs approximately 572 lb. This is more than the original crosshears weighed, but on account of some failures it was later found necessary to strengthen these castings and the weight was thereby increased somewhat. The calculated direct stress on the piston rod due to thrust was only 5,529 lb. per sq. in. It does not appear that such a low load, even after allowing for the weakening effect of tool marks and irregularities in the fit, should develop a stress in excess of the fatigue limit of ordinary steel. Probably with a conventional alligator-type crosshead with a balanced load this would be true and failures would not have been so numerous nor have developed in so short a time. However, in addition to the direct stress there are several other sources of stress, some of uncertain magnitude, which must be taken into account. One of the most uncertain of these is the tensile stress produced when the rod is drawn into the crosshead by the key. The intensity of this stress depends upon the accuracy of the machining. This factor of uncertainty cannot be eliminated in any event, but in the present case it appears not to have been the principal cause of failure. Rods fitted at the plant of the locomotive builder, as well as rods fitted at various shops on the Milwaukee failed. The effect of accuracy in the fit is, therefore, assumed to be only one of several rather than the principal source of stress causing early failure.

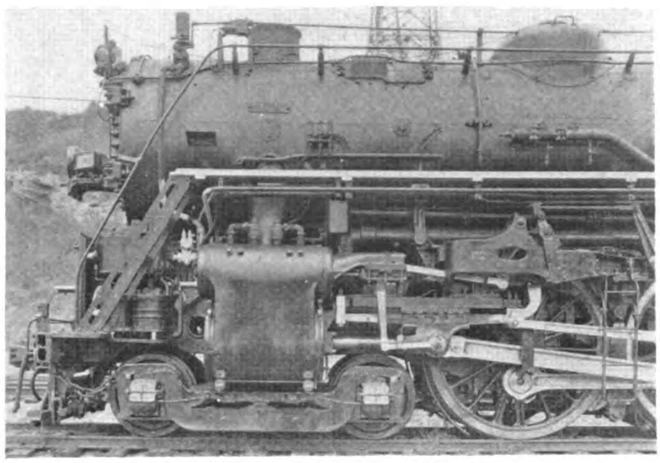


Fig. 1—Milwaukee 4-6-4 locomotive equipped with Laird-type crossheads

The crosshead is so heavy that it produces a bending stress of considerable magnitude in the rod. This becomes a maximum when the piston is at the back end of the cylinder and is not a negligible stress. The bending stress produced by the weight of the crosshead, plus inertia loading developed by the whip of the crosshead each time it changed direction of travel, was so great that all cracks started on the top of the rod. Fig. 2 shows diagrammatically the location of the origin of the fractures. The centrifugal stress increases as the guides and crosshead shoes wear, becoming a maximum when the clearance between shoe and guide reaches the permissible limit. A compressive stress is also produced in the rod by the crosshead when the piston key is driven home. This is in addition to the tensile loading mentioned above. It is possible to calculate this load theoretically but practically such a calculation has little value. The smoothness of the surfaces as well as the accuracy of the fit affects both this stress and the tensile stress. F. Williams, Canadian National, has recommended grinding piston rods to produce the best possible surface and fit and thus reduce this stress to a minimum as a means of reducing failures. Others do not consider this necessary and argue that it does not in fact produce any better situation than can be obtained by good machining. The piston rods under discussion in this article were not ground but a good smooth job of turning was done.

In addition to the stresses considered so far, there is the load due to column action from the axial steam loading. Taking normal values for this and all the other

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† Metallurgical and welding engineer, Chicago, Milwaukee, St. Paul & Pacific.

known sources of loading it has been calculated that at a speed of 80 miles an hour there is a possible stress of 22,400 lb. per sq. in. in one of these piston rods 5¼ in. in diameter. At least half of this load is due to inertia forces from the unbalanced loading. A load of 22,400 lb. per sq. in. is approximately half of the fatigue strength of the plain carbon steel that was used. It is, therefore, quite apparent that the actual loads were much higher than the maximum calculated.

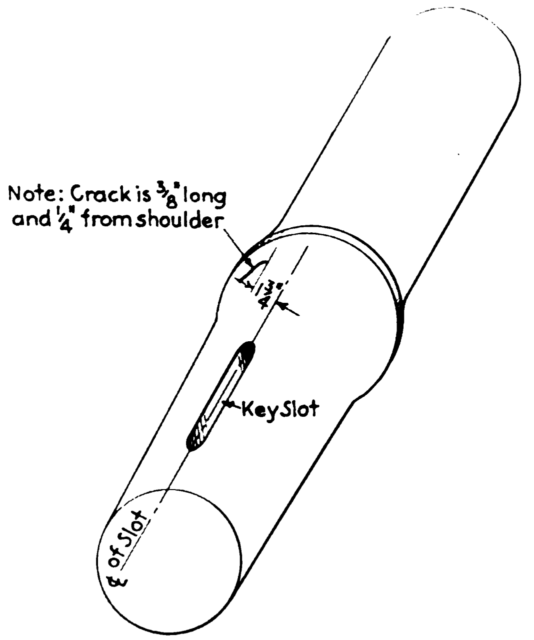


Fig. 2—Origin of typical crack in right piston rod

Even rods with much higher fatigue strength also failed. Much of the high stress is believed to be due to the use of a key in fastening the piston rod in the cross-head. The authors have for a long time believed that the key type of fastening for piston rods is an archaic device not well adapted for the purpose. Perhaps one should not criticise without having something better to offer but it is felt very strongly that a better fastening device can and should be found.

Originally the key was the indirect cause of many piston-rod failures even with the alligator-type crosshead. Cutting the slot in the rod frequently was done very crudely. A rough edge on the slot, or tool marks in the slot itself, acted as stress-raisers and caused the rod to break either at the end or sometimes in the middle of the slot. When this condition was remedied by better machine work, fractures began just back of the collar on the rod. It seems quite clear that in many cases the collar was drawn up against the front of the crosshead before the key had been driven in completely. Driving it further set up a heavy stress between the collar and the slot. Service stresses, combined with those already existing from driving the key, developed cracks which quickly spread across the entire section. If the collar did not strike, then the rod was wedged into the barrel so tightly that stress was set up at the end of the crosshead, or at the end of the fit just inside the barrel and failure developed as before. This condition occurs not only with the Laird-type crosshead, but is also found in the alligator-type, although not so frequently on the Milwaukee. Mr. Williams, has shown, however, that even the fits with smooth surfaces obtained by grinding do not insure complete freedom from this type of failure. Grinding removes tool marks, which certainly act to some extent as stress raisers. But the damage that can be done by the key may offset all that is gained by grinding.

Average Life of Piston Rods

The failures on the F-6 engines mentioned above practically all started in the same place as shown in Fig. 2. Fractures were located just back of the collar sometimes only 1/16 in. back and at other times further than this, probably depending upon where the fit terminated. The cracks were always on the top between the collar and the keyway; the piston rods could have been identified as left or right by this means alone had they not been marked otherwise. The cracks spread from the top squarely across the rod, never exhibiting angularity. Careful and complete examination, including analysis, test bars, etching, sulphur printing and micro-examination, was made of many of the first rods that failed without finding evidence of faulty material.

Table I—Average Composition and Physical Properties of Plain Carbon Steel Piston Rods 5¼ in. and 5½ in. in Diameter

Carbon	0.51 per cent	Yield point	53,000 lb. per sq. in.
Manganese	.60 per cent	Tensile strength	90,000 lb. per sq. in.
Phosphorus	.011 per cent	Elongation in 2 in.	26.0 per cent
Sulphur	.025 per cent	Reduction in area	45.0 per cent

The rods were made from plain carbon steel, normalized and tempered of the composition and properties shown in Table I. The service life of these rods, which were 5¼ in. in diameter, is shown in Table II.

An average life of 87,000 miles for a piston rod meant only about eight months of service. Even if all the cracked rods could be found on inspection so that there would be no failures in service this was not a very satisfactory situation. It was, therefore, decided to try some different types of steel to determine if longer life and greater freedom from cracking could be obtained.

The various steels listed in Table III were all tried. No. 1 was a chrome-nickel-molybdenum steel generally believed to be particularly tough in the quenched-and-tempered condition, especially in large sizes. The Brinell hardness number 235, seemed at that time rather high but this steel was known to have reasonably good machinability, and at this hardness could be handled satisfactorily. No. 2 was a manganese-vanadium steel, normalized and tempered which also had rather good ductility, high yield point, and higher strength than the plain carbon rods. No. 3 was a low-carbon-nickel steel, normalized and tempered. This steel had a high yield point and extremely high ductility but about the same tensile as the plain carbon steel. No. 4 was a high-grade wrought iron low in tensile strength compared with the steels but reputed to be tough. No. 5 was the same plain carbon steel which was used originally, but in the quenched-and-tempered condition. These rods had higher tensile, yield, and Brinell than any of the other rods and

Table II—Mileage of Carbon-Steel Piston Rods Normalized and Tempered

Diameter of rods	5¼ in.	5½ in.
Number of rods tested	74	74
Number of rods fractured	54	32
Rods worn to limit	5	15
Miscellaneous * (Not included in mileage)	15	14
Average mileage	86,900 (59 rods)	203,100 (60 rods)
Minimum mileage	10,300	23,500
Maximum mileage	214,200	460,800
Average mileage of rods worn to limit of wear	153,000	305,125
Rods still in service	None	13

* Includes rods removed on account of failure of some other part, rods removed and not reported, and others with records not clear.

appreciably lower ductility, especially elongation. They, of course, were not as easy to machine as the normalized rods but they did not offer any excessive difficulty. Micrographs of all but the iron rods are shown in Fig. 3.

The results obtained with these rods are presented in Table IV and offer some interesting indications even though there were not enough of each type of rod tested to produce really conclusive results. However, since the service conditions were all very much alike and the rods were practically all being tested concurrently, on some of the 14 locomotives or the seven similar engines received about a year later, it is probable that the figures do reveal some real differences in the characteristics of the metals used.

Table III—Properties of Test Piston Rods (Chemical Analyses Shown in Per Cent)

	Chrome-nickel molybdenum No. 1	Manganese-vanadium No. 2	Low-carbon-nickel No. 3	Wrought iron No.4	Quenched and tempered plain carbon No. 5
Carbon	0.36	0.28	0.27	...	0.51
Manganese	.56	1.46	.92	.07	.79
Phosphorus	.010	.024	.031	...	.025
Sulphur	.015	.023	.029	...	.041
Chromium	.77	.18	.14	...	.08
Nickel	1.44	...	2.54	...	...
Vanadium	...	.18	...	...	...
Molybdenum	.24	...	...	...	...
Yield point lb. per sq. in.	92,800	64,300	60,000	29,800	85,900
Tensile lb. per. sq. in.	115,900	93,300	86,000	45,800	130,000
Elongation in 2 in. per cent	24.0	24.0	32.0	28.1	18.0
Reduction in area per cent	63.4	58.6	62.0	40.4	45.2
Brinell	235	190	170	...	285 (surface)

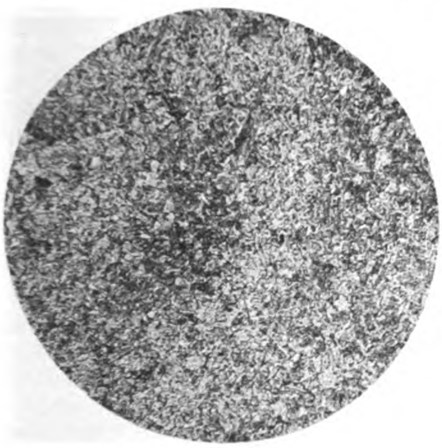
It will be noted that the chrome-nickel-molybdenum rods did not in any case reach the limit of wear. The results with this steel were a distinct disappointment and there is nothing to show why they were not better. The wrought-iron rods, while they had low strength and not extremely high ductility, nevertheless gave good results from the standpoint of cracking in service. But the resistance to wear was low and the original cost was approximately twice as much as for plain carbon rods. The low-carbon-nickel rods were so soft they had poor resistance to wear. Although they are characterized by high ductility they were not proof against cracking. All the manganese-vanadium rods that were accounted for failed by cracking but the resistance to failure was very good as they ran to high mileages before cracks developed. The hard, plain carbon-steel, rods gave surprisingly good results. Although of high hardness on the surface they were sufficiently tough to resist cracking very well and did not crack at low mileage as did some of the soft rods. The resistance to wear also was good.

Table IV—Service Life of Special Piston Rods

Material (see Table III)	No. 1	No. 2	No. 3	No. 4	No. 5
Number of rods	7	6	16	8	6
Minimum miles	25,500	154,800	76,500	11,500	62,100
Maximum miles	178,150	201,800	180,800	124,000	247,800
Average miles	132,600	178,000	99,300	54,000	177,700
Number worn to limiting size	0	0	6	3	2
Number fractured	5	4	7	4	2
Accounted for otherwise	1* 1†	2*	3†	1*	2‡

* Bent through failure of other parts.
† No record.
‡ Poor fit.

These results were responsible for the present practice of using quenched-and-tempered piston rods of plain carbon steel on these engines. It is apparent now from the few that have so far been put into service in the 5½-in. size of a modified design, that they do not have as great a tendency to crack as the softer, more ductile rods.



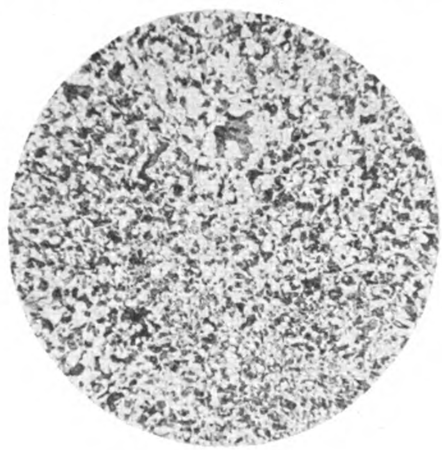
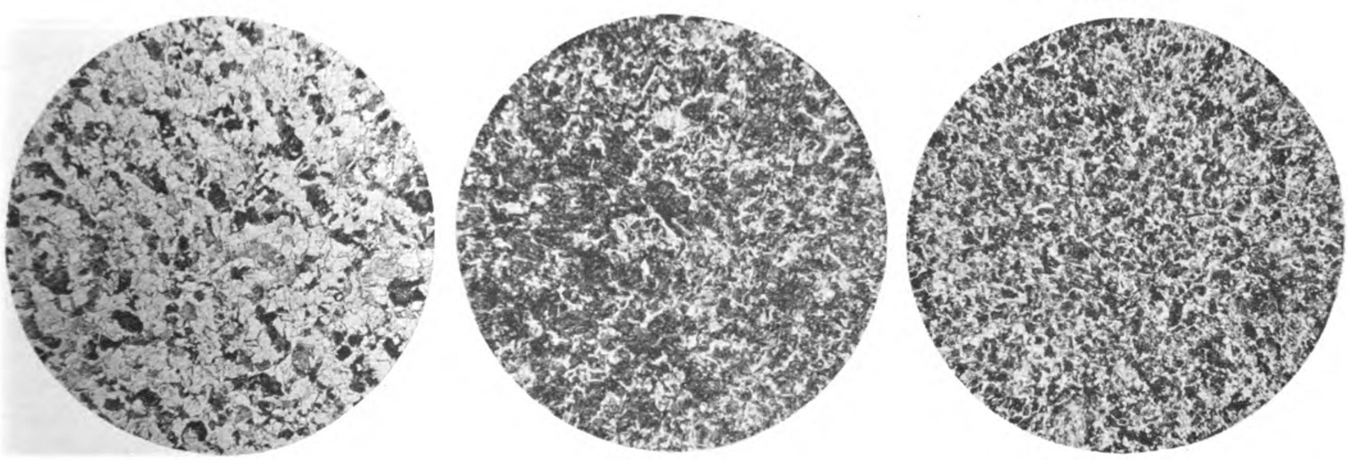


Fig. 3—Micrographs of steel piston rods tested on the C. M. St. P. & P.—100 diameters

Left—Chromium-nickel-molybdenum steel.
Right—Manganese-vanadium steel.
Lower left—Low-carbon-nickel steel.
Lower right—Manganese-vanadium steel.
Center—Quenched and tempered carbon steel.



None of the rods of the larger size have been in service long enough to permit estimating what the ultimate life will be. It will also be seen from Table V that the cost of the quenched-and-tempered rods is only a little greater than for a normalized-and-tempered rod of the same size and considerably less than the cost of the special rods.

Change in Size and Design

It was quite evident from the results of the tests of the alloy and heat-treated rods that they did not provide an entirely satisfactory solution to the piston-rod trouble. It was, therefore, decided to try a larger rod of somewhat different design. The new and old designs and sizes are shown in Fig. 4. The diameter was increased from 5¼ to 5½ in., the radius where the head joins the body was increased from 1 to 3 in., and the collar was omitted entirely. There did not appear to be any advantages in having the collar and there was a distinct possibility that it was a source of unknown and undesirable stress if the rod were drawn into the barrel of the crosshead far enough for the collar to act as a stop. The new style rods have now been tested quite extensively in plain carbon steel, normalized and tempered. The results obtained are shown in Table II along with the 5¼-in. rods. This shows that an increase of ¼ in. in the diameter of the rod raised the average life from 87,000 to 203,100 miles. The same quality of steel was used in the 5½-in. rods as was previously used in the 5¼-in. plain-carbon rods. Table VI brings out the great increase in life that resulted when the size and design were changed but, as is shown later, other factors probably influenced these results. It should also be borne in mind that the 5½-in. rods actually are even better than the tables indicate. There are still 13 of these rods in service and they have already averaged over 350,000 miles and one has exceeded 500,000 miles. When these are finally all removed the average mileage shown in the second column of Table II will be considerably more than the 203,000 miles shown.

Table V—Cost of Piston Rods of Varying Size and Chemical Analyses

Material	Approximate cost of rough-turned rods
Carbon steel normalized and tempered 5¼ in. diameter	$22.50
Carbon steel normalized and tempered 5½ in. diameter	23.00
Carbon steel quenched and tempered 5¼ in. diameter...	29.00
Cr-Ni-Mo quenched and tempered 5¼ in. diameter......	45.00
L-C-Ni normalized and tempered 5¼ in. diameter......	38.00
Mn-V	38.00
S. A. E. 2340 quenched and tempered 5½ in. diameter	29.50
Wrought Iron	50.00

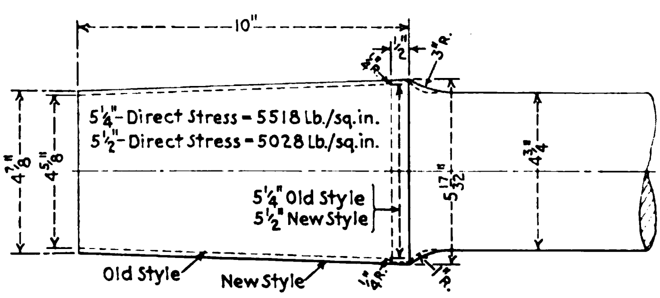


Fig. 4—Piston rod with new and somewhat larger crosshead fit which has shown good results on the Milwaukee

Quenched-and-tempered plain carbon rods of the new design and size are now standard for these engines and records are being kept to determine how much longer life they will have than the normalized rods.

The longer life and greater freedom from cracking shown by the 5½-in. rods is not believed to be due solely to the increase in diameter and change in shape. As shown in Fig. 4 the new design of rod has a direct stress only about 10 per cent less than the 5¼-in. rod.

One change that has been made in maintenance practice accounts for at least part of the decreased tendency to crack. The guides on one side of the locomotives have for some time been set a little closer together than on the opposite side. When the crosshead shoes wear one is scrapped and the other is transferred to the narrow side. In this way the amount of wear that is permitted to develop is kept low without any increase in the number of crosshead shoes consumed. By holding the clearance between the shoes and guides to a minimum there is considerably less whip of the crosshead at each end of the stroke. The stress is, therefore, also reduced and this must have a favorable effect in keeping the stresses induced by inertia forces to a minimum.

Rods Made from Hot-Rolled Round Bars

The latest type of piston rod that has been investigated and tried in service on the passenger engines is one from S. A. E. 2340 steel with approximately 3½ per cent nickel and 0.35 per cent carbon. The rods were machined from hot-rolled rounds 5¾ in. in diameter that had been quenched and tempered. This, of course, is a departure from standard practice since heretofore rods have always been made from billets by forging or pressing. The hot-rolled rounds are a cheaper source for a rough-turned rod than the hammered blanks. The test with four of these rods is not yet finished, one still being in service with an accumulated mileage in excess of 457,000 miles. One rod has reached the limit of wear.

Table VI—Mileage of Carbon Steel Test Rods Normalized and Tempered (Includes only those which wore to the limit or cracked)

	Per cent of 59 rods (5¼ in. dia.)	Per cent of 60 rods (5½ in. dia.)
0 to 100,000 miles	64.5	21.6
100,000 to 200,000 miles	34.0	35.0
200,000 to 300,000 miles	1.5	20.3
300,000 to 400,800 miles	0.0	23.1

In the case of this particular rod it was applied to the right side of an engine at the same time that one of the 5½-in. normalized-and-tempered carbon rods was applied on the opposite side. These two rods remained on the engine and were removed at the same time because of both reaching the limit of wear after 367,100 miles of service. The nickel steel was not superior to the plain carbon steel in resistance to wear in this case. None of them were removed because of other failures which resulted in the rods being bent or otherwise damaged.

The average mileage at present of the four rods applied is 295,000, which includes one that was removed at 111,300 miles on account of being bent. The composition and physical properties are shown in Table VII. These rods do not have as high tensile strength as some of the special rods tested in the 5¼-in. size, but do appear to have fair resistance to wear and good resistance to failure. This suggests the idea that some of the rods

Table VII—Three and One-Half Per Cent Nickel Steel Rods Quenched and Tempered

Carbon	.37	Yield	78,000 lb. per sq. in.
Manganese	.66	Tensile	103,500 lb. per sq. in.
Phosphorus	.014	Elongation in 2 in.....	24.0 per cent
Sulphur	.019	Reduction in area	59.5 per cent
Nickel	3.40		
Chromium	.15		
Silicon	.17		

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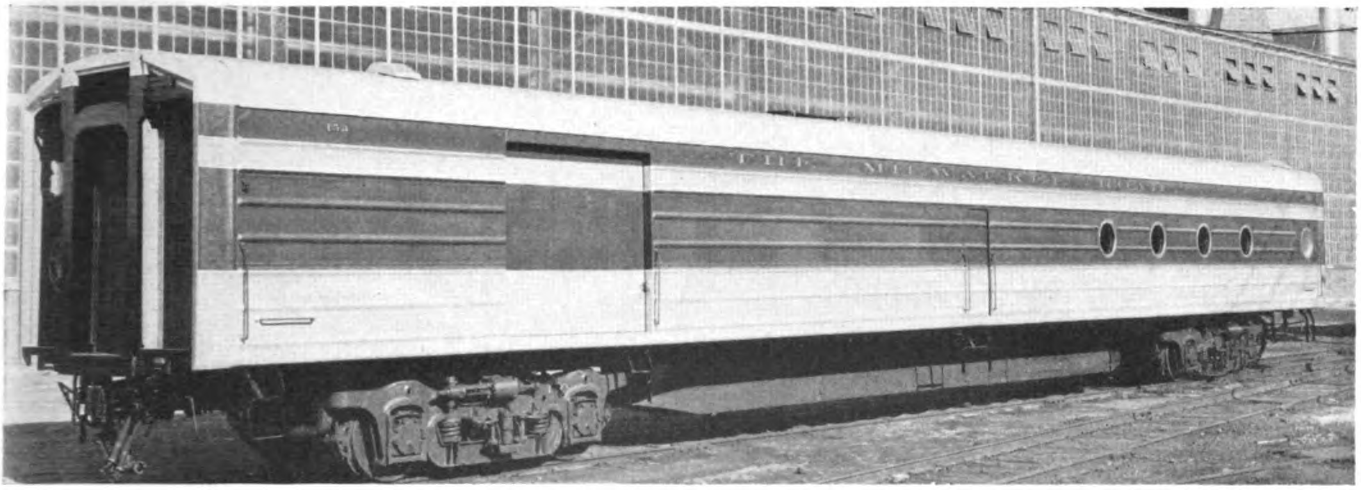


Express-tap-room car notable for the use of circular windows in the passenger-section

Milwaukee Builds

More Welded Passenger Cars

Lightweight cars of alloy steel mark the third step in evolution of modern passenger rolling stock designed and built by this railroad

THE Chicago, Milwaukee, St. Paul & Pacific recently placed in service 35 new passenger-train cars which are being used primarily to replace former equipment on the Hiawatha. There are 15 standard coaches, 6 drawing-room-parlor cars, 4 beaver-tail parlor cars, 4 express-tap-room cars, 4 diners and 2 railway postoffice cars. The Hiawatha car equipment replaced by the new cars is being used in trains not previously air conditioned. The new cars, which were built by the railroad in its own shops, are of lightweight, alloy-steel construction, largely fabricated by welding. The designs are the work of the engineers of the railroad collaborating with Otto Kuhler, consulting engineer of design at New York, who was responsible for interior architectural treatment, decoration and arrangement of facilities.

In these cars focused lighting has been improved by fitting the lenses with metal louvers to eliminate practically all glare. The inside surfaces of metal car sides, ends, floors and roofs are treated with a plastic sound deadener. The air-conditioning system includes a more satisfactory method of air distribution than that employed in the cars of welded construction previously built by this railroad. The four-wheel lightweight roller-bearing truck is of entirely new design, utilizing coil-spring suspension exclusively in conjunction with hydraulic shock absorbers and including a bolster-stabilizing device to control sidesway. Rubber insulation is employed in the truck to an unusual degree.

These cars comprise the third set of new equipment for the Hiawatha. Each unit of the train consists of an express-tap-room car, four luxury coaches, a cafe-dining car, two drawing-room parlor cars and one beaver-tail parlor-observation car. The coaches and parlor cars have vestibules at one end only. The express-tap-room car and dining cars have no vestibules.

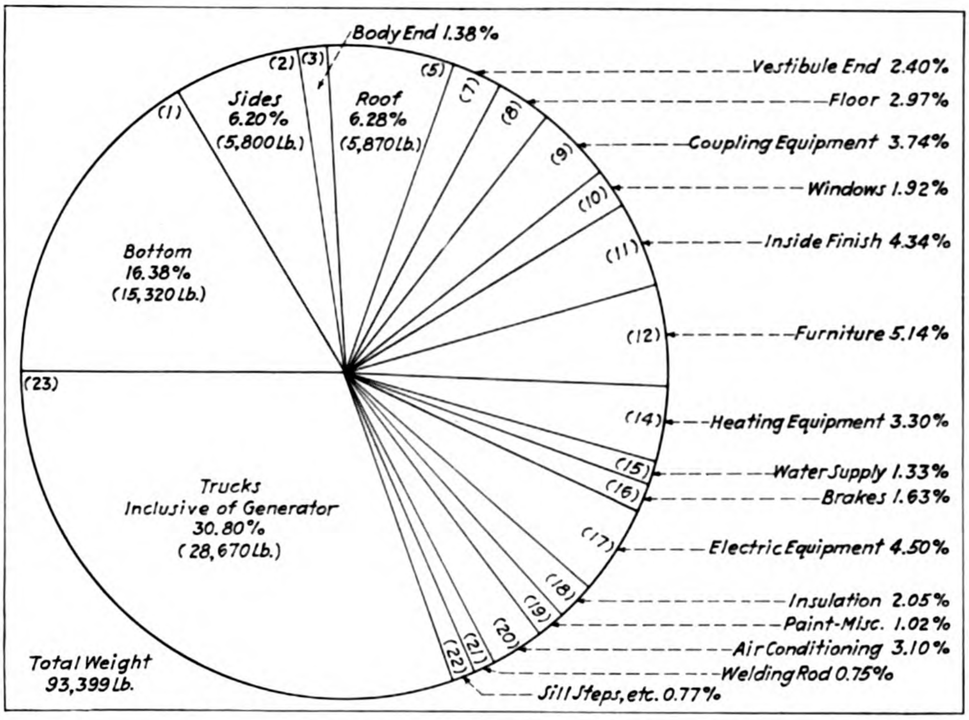
Structural Features of 1938 and 1936 Cars

The construction of the 1938 cars is very similar to that of the cars built in 1936. Cor-Ten steel is used throughout and the same fundamental principles of construction are employed. New window shapes and grouping of windows have been introduced in all cars, including the tap-room cars which have port-holes overlooking the tables. The underneath equipment is again suspended under the center of the car, but the shrouding is extended to present a smooth appearance from bolster to bolster.

The contour of the roof is slightly changed, circular arcs being substituted for the logarithmic curve previously used. This simplifies the fabrication of the carlines and permits the use of carlines rolled to contour instead of being die formed. The side construction is also modified to obtain more lateral stiffness by providing continuous longitudinal members above and below the windows, these members being formed by pressing. The intermediate side sheets are formed into

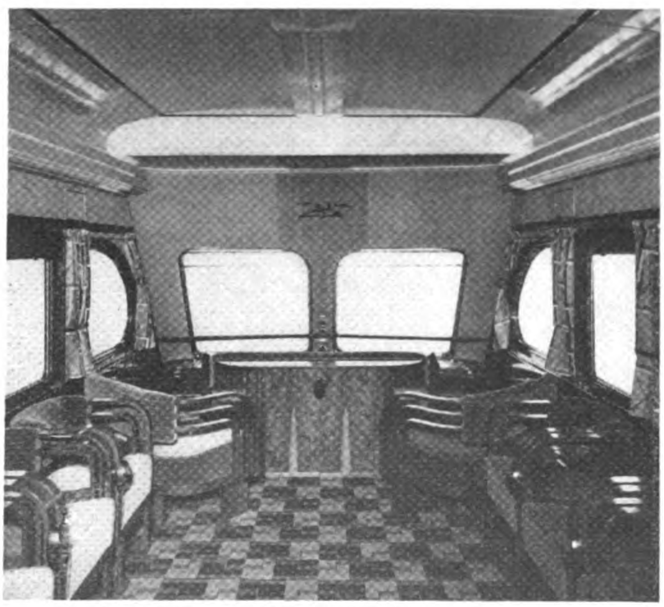
Scale Weights and Seating Capacities of Hiawatha Trains of the C. M. St. P. & P.

	1934 Hiawatha		1936 Hiawatha		1938 Hiawatha	
Type of car	No. of cars	Weight, lb.	No. of cars.	Weight, lb.	No. of cars	Weight, lb.
Express tap-room	1	131,500	1	96,200	1	98,800
Coach	4	448,800	4	379,600	4	373,600
Diner	..	......	1	102,300	1	105,400
Parlor car	1	113,700	1	95,100	..	......
Drawing-room parlor	..	......	1	95,200	2	186,600
Beaver-tail parlor	1	112,900	1	92,000	1	91,700
Total car weight	7	806,900	9	860,400	9	856,100
Number of revenue seats		238		291		300
Number of non-revenue seats		138		173		199
Total seating capacity		376		464		499
Car weight per passenger seat		2,146		1,854		1,716



Weight distribution of the Milwaukee 1938 coach

pans with flanges extending horizontally inward to the inside face of the side posts, and then vertically upward and downward along the post faces. The horizontal flanges of the side pans are slotted to receive the side posts which are threaded through the slots, each side pan being spot welded to the flanges of the posts in the flat section and arc welded to the post at the flanges of the pan. The window openings in the intermediate side



The large rear windows are an attractive feature of the observation room

sheets are cut out with a special torch. The intermediate side sheets, with their complement of side posts, form the principal elements of the side-frame assembly.

In the assembly of the side frame, the top, or letter-board sheets, and the lower side sheets are welded together in suitable clamps into a continuous length. The intermediate side-sheet assemblies are then laid in their proper sequence on the lower and upper side sheets and the side posts welded thereto. The flanges of the side pans are then securely welded together to form a continuous longitudinal stiffener.

The 1936 cars had corrugations in the side sheets above and below the wnidows only, while the present cars have a total of seven such corrugations, five extending the full length of the side while two in the side pan are interrupted by the windows. These corrugations also contribute to lateral stiffness and aid materially in obtaining smooth-appearing side sheets.

The floor construction is also modified slightly in that the pan construction is replaced by Z-shape floor supports welded to the floor beams. The side sills are increased from 3-in. to 4-in. Z-shapes, which not only strengthen the side construction but also afford better fastening for the floor supports and side posts to the side sills.

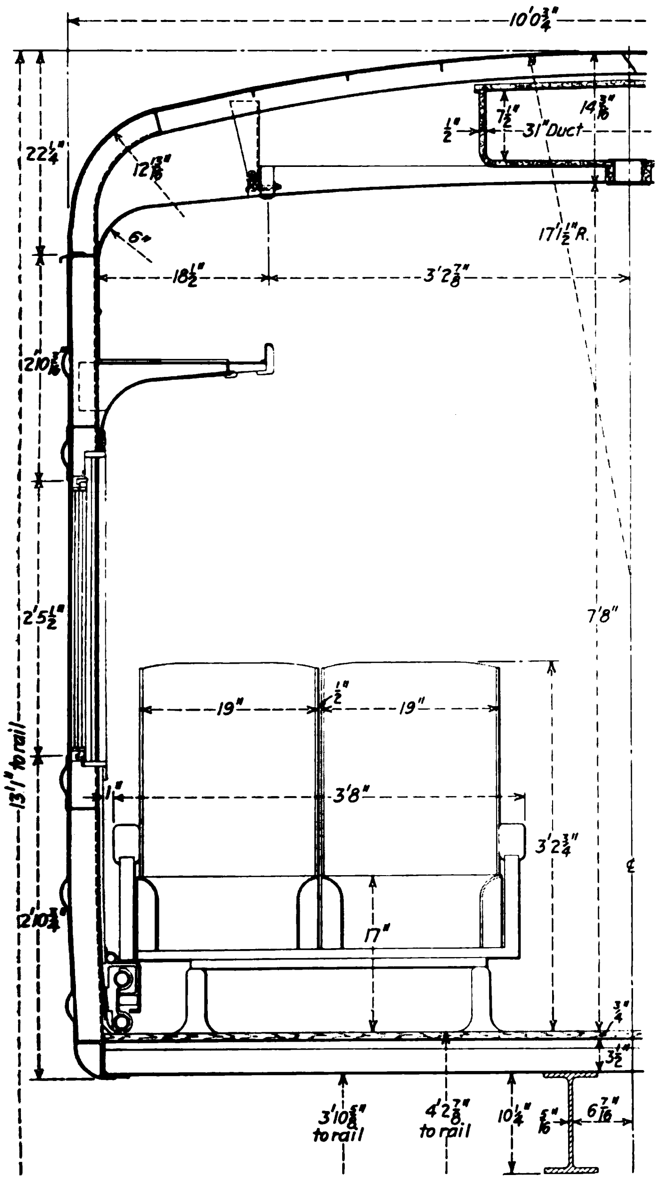
The interior arrangement is extensively modified by the total elimination of all metal trim. This includes the inside window sash, window frames and sills which, in the 1936 cars, were made of extruded aluminum and, in 1938 cars, are walnut. The other sash, however, are the same as used in 1936 and the inside sash are hinged in the same manner.

Heating is changed from a blast system to a combination of direct fin radiation along the floor, with positive air circulation provided by a blower. Air passing through the blower is tempered by means of a set of heating coils to offset the lower temperature of the fresh air taken into the car by the ventilating system. The floor radiation is of the new Vapor single-pipe arrangement in which the steam-supply pipe is inside the fin pipe. These changes in the heating system resulted in a considerable weight reduction. The method of air distribution is also changed and, instead of introducing the air into the car through grilles in the side walls, the air is now introduced through a trough in the center of the ceiling.

Details of Truck Construction

Important changes are also made in the trucks used under the new cars which are of the four-wheel, lightweight alloy-steel type, with conventional swing-motion

bolsters and spring planks and all journals fitted with Timken roller bearings. The truck, with the truck-mounted generator, weighs 14,961 lb., which may be compared with 15,913 lb. for the 1936 truck and 15,195 lb. for the 1934 truck. The non-generator equipped truck weighs 13,709 lb.



Half-section through the 1938 passenger cars of the C. M. St. P. & P.

Plywood Used on 35 Milwaukee Main Line Passenger Cars

HEAD-END PASSENGER EQUIPMENT

Floors: 1¼-in. 9 ply resin glued Douglas fir
Sides: ¾-in. 5-ply resin glued Douglas fir treated with a resin sealer to exclude moisture
Ceiling: ¼-in. 3-ply fir treated with a resin sealer

PASSENGER-CARRYING CARS

Floors: ¾-in. 5-ply Douglas fir treated with a resin sealer
Wainscoating: ½ in. 5-ply bass wood with Mid-West walnut veneer face and 1/16-in. Kentucky poplar back coated with aluminum paint
Pilaster panels: Alternate fluted Mid-West walnut and ½-in. 5-ply bass wood with bleached curly maple face and Kentucky poplar back
Basket rack cove: 3/16-in. 3-ply bass wood with bleached curly maple face; trim is solid walnut
Ceiling: ¼ in. 3-ply poplar, covered with aluminum leaf on the exposed under surface
Partitions: ¾-in. 5-ply bass wood with bleached curly maple faces to window sill line; Mid-West walnut veneer used from then to the floor line
Doors: 1¾-in. 7-ply fir with Mid-West walnut veneer faces and solid walnut edges

DINING CARS

Stainless-steel-faced plywood in kitchen and pantry furnished by the Haskelite Mfg. Co., Chicago
Metal faced plywood with black enamel finish, used in men's rooms, supplied by the Metal-Wood Corp., Chicago

Partial List of Materials and Equipment on 35 New Milwaukee Main-Line Passenger Cars

High-tensile low-alloy steel for welded car structures	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Aluminum sheets and tubing for baggage doors, air ducts, etc.	Aluminum Company of America, Pittsburgh, Pa.
Lightweight rolled-steel wheels	Edgewater Steel Company, Pittsburgh, Pa.
	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Heat-treated carbon steel axles	Standard Forgings Company, Chicago
Roller bearings on all journals	Timken Roller Bearing Company, Canton, Ohio
Truck and car end castings	General Steel Castings Corp., Granite City, Ill.
Truck coil springs, alloy steel	Railway Steel Spring Company, New York, N. Y.
Unit-cylinder clasp brakes	American Steel Foundries, Chicago
Self-locking truck center pins	W. H. Miner, Inc., Chicago
Air brakes, Schedule H. S. C.	Westinghouse Air Brake Co., Wilmerding, Pa.
Safety hand brakes, Ideal	W. H. Miner, Inc., Chicago
Couplers and yokes, high-tensile cast steel	Buckeye Steel Castings Co., Columbus, Ohio
Friction buffers and draft gears	W. H. Miner, Inc., Chicago
Rubber used in truck construction	United States Rubber Co., New York, N. Y.
Coupler and buffer stem wear pads	Fabreeka Products Company, Boston, Mass.
Bolster vertical shock absorbers	Monroe Auto Equipment Co., Monroe, Mich.
Steam jet air-conditioning system	Safety Car Heating & Lighting Co., New York, N. Y.
Heating equipment and temperature control	Vapor Car Heating Company, Chicago
Car lighting generators, 10 kw	Safety Car Heating & Lighting Co., New York, N. Y.
Electric storage batteries	Electric Storage Battery Co., Philadelphia, Pa.
	Gould Storage Battery Co., Depew, N. Y.
Charging receptacles	Albert & J. M. Anderson Co., Boston, Mass.
Electric exhaust fans	Holmes Fan Company, Chicago
Air filters	Air-Maze Company, Chicago
Water coolers	Ebco Mfg. Company, Columbus, Ohio
Hardware and anti-pinch hinges	Loeffelholz Company, Milwaukee, Wis.
Truck lock washers	A. M. Castle Company, Chicago
Self-tapping screws	Shakeproof Lock Washer Co., Chicago
Insulation:	
Stonefelt, 2½ in. thick in floors	Johns-Manville Sales Corp., New York, N. Y.
Hair felt around air-cond. ducts	American Hair & Felt Co., Chicago
Dry Zero, flameproof, 2½ in. thick in sides, ends and roofs	Dry-Zero Corporation, Chicago
Cork board, 2½ in. thick in ice boxes, bottle lockers, etc.	Armstrong Cork Prod. Co., Lancaster, Pa.
Felt stripping used between inside metal sheets and posts	Western Felt Works, Chicago
Dednox applied to inside metal sheets for sound deadening	Dednox, Inc., Chicago
Pipe covering	Johns-Manville Sales Corp., New York, N. Y.
	Union Asbestos & Rubber Co., Chicago
Ventilators	Railway Utility Company, Chicago
Wash stands	Standard Sanitary Co., New York, N. Y.
Hoppers	Duner Company, Chicago
Outside window sash	Adams & Westlake Company, Elkhart, Ind.
Glass—De-hydrated sash used in observation car ends	Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Window shades	Railway Curtain Company, Chicago
Lighting fixtures	Loeffelholz Company, Milwaukee, Wis.
Coach seats	Heywood-Wakefield Company, Boston, Mass.
	Coach & Car Equipment Co., Chicago
Dining car chairs	General Fireproofing Co., Youngstown, Ohio
Observation lounge chairs	American Chair Company, Sheboygan, Wis.
Plush seat covering and drapes	L. C. Chase & Co., Inc., New York, N. Y.
Plush seat covering	Massachusetts Mohair Plush Co., Boston, Mass.
Leather seat covering	Cleveland Tanning Co., Cleveland, Ohio
Ajax drinking cup dispensers	Logan Drinking Cup Company, Chicago
Radio and loud speakers	Galvin Mfg. Company, Chicago
Marker lamps	Pyle-National Company, Chicago
Stainless steel-faced plywood in diner, kitchen and pantry	Haskelite Mfg. Company, Chicago
	Metal-Wood Company, Chicago
Plywood for car interiors	Algoma Plywood & Veneer Co., Chicago
	Harbor Plywood Co., Hoquiam, Wash.
	Wheeler-Osgood Co., Tacoma, Wash.
Exterior paints	Murphy Varnish Co., Chicago

One feature of the new truck design is the entire elimination of elliptic springs which are replaced by large triple-coil alloy-steel spring groups, the outer spring being 14 in. in diameter. These spring groups have a difference of 14 in. between the free height

One of the parlor cars—the interior finish is American walnut and bleached maple—louver lights are shown under the luggage racks

and the working height, thus providing an unusual degree of flexibility and "spring."

To promote easy riding by the damping of vertical oscillation, the truck is equipped with Monroe hydraulic shock absorbers applied between the bolster and the spring plank, one on each side of the truck. Automotive-type levelizing bars also extend across the truck frame and are connected to the bolster by swing hangers. These bars operate in such a way as to steady the bolster and keep it level by transferring or equalizing the unbalanced load on the bolster springs when one side of the truck moves up or down due to irregularities in the track surface. The trucks are equipped with medium lightweight, rolled-steel wheels, heat-treated carbon-steel axles, General Steel Castings truck frames, Simplex unit-cylinder clasp brakes and Westinghouse H. S. C. air-brake equipment. To assist still further in smooth train handling when braking, Miner velvet-action passenger draft gears are installed.

Another feature of the new truck is the extensive use of rubber to dampen vibration and eliminate shock and noise in so far as possible. For example, a circular rubber pad 1-in. thick in the bottom of each bolster center plate carries the car weight, and vulcanized steel and rubber segments line the center-plate flange. The Miner self-locking truck center pin is rubber-bushed. Circular rubber pads are applied on top of the large bolster coil springs. Bolster bumper blocks are made of rectangular rubber pads. Bolsters are positioned by four large rubber-insulated bolts which prevent bolster contact with the chaffing plates. Rectangular rubber pads are applied under the friction side bearings and the holding bolts are also set in rubber. The generator-support bearings are made of rubber and the Monroe bolster snubbers are insulated by four rubber bushings. The levelizing bar and hangers also are rubber-bushed and a rubber hose is used to cover the hand-brake wire cable.

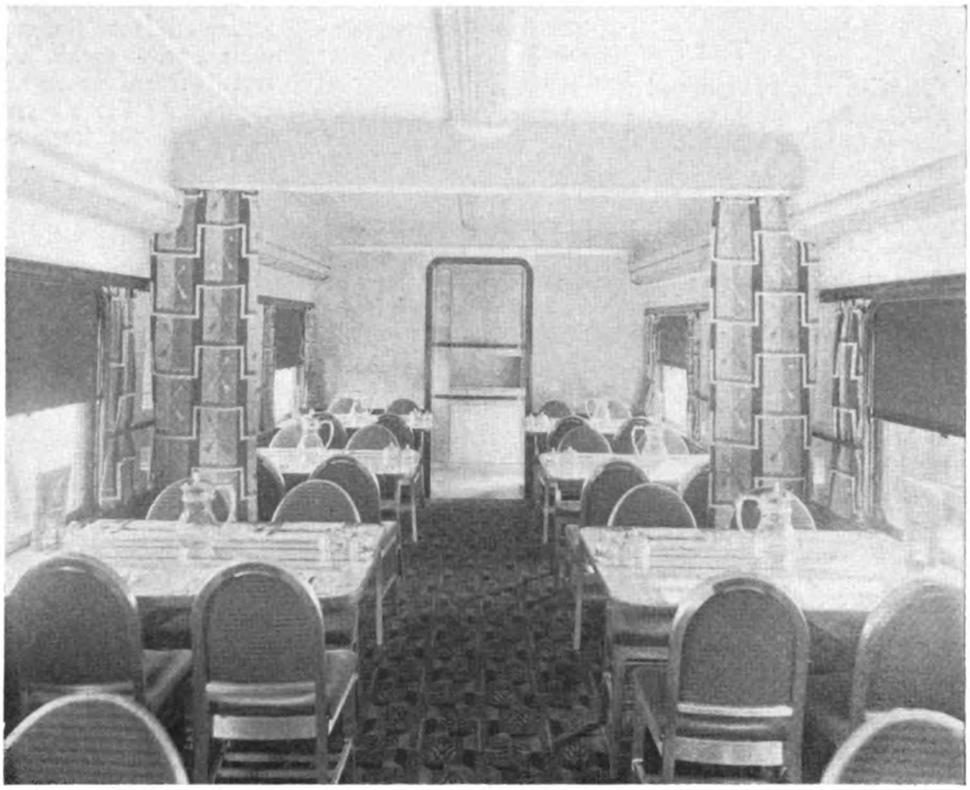
Car Parts Made at Milwaukee Shops

In addition to fabricating Hiawatha car structures by the welding process at Milwaukee shops, the following car parts were manufactured locally: Truck equalizers, made from flame-cut and welded I-beams; bolster swing hangers, forged; friction side bearings; roller-bearing housings, inner and outer; generator and axle pulleys, V-belt type; diaphragms, inside and outside; folding vestibule steps; air ducts and grilles; water tanks; basket racks; interior finish, American wood veneers, including doors, partitions and side walls; bar fronts; aluminum baggage-car doors, and wood smoking-room furniture. A feature of these cars is the extensive use of plywood on the interiors. The various locations are shown in the table.

Interior Appointments of the New Cars

The general scheme of interior decorations of these cars centers around the use of native woods and softness rather than brilliance of tone in color and ornamentation. The interior finish of the walls is in native walnut and bleached maple, and most of the exposed metals in ash trays, window hardware, etc., is a dark gun-metal finish. Stainless steel or brush-finished chrom-

Method of application of Dry Zero insulation in one of the new Hiawatha cars



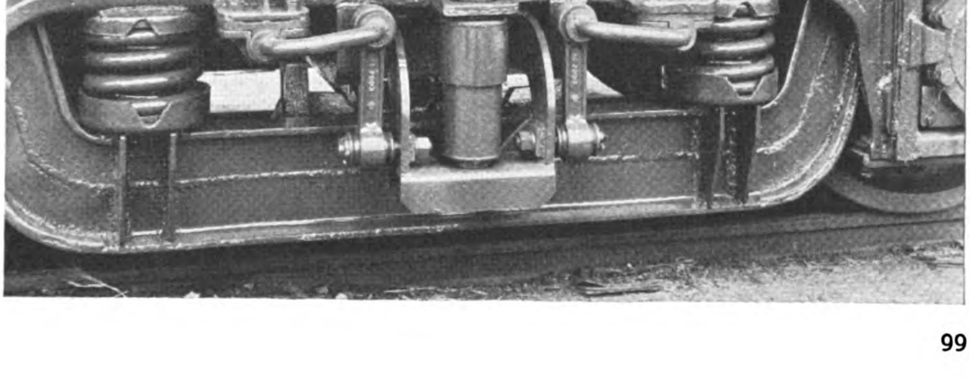
Looking toward the cafe section in the dining car

ium has been used only on vestibule door handles, handrails, etc., where the gun-metal finish would not withstand the effect of constant handling.

The express-tap-room car has a 30-ft. space in the forward end available for baggage and express, and a 41-ft. 6 in. cocktail-lounge and tap-room section seating 44. Adjoining the bar, which is across the front end of this part of the car, is a cocktail lounge seating 12 persons. The lighting is indirect, coming from lamps which are placed behind the ceiling bulkhead which divides the cocktail lounge from the tap room.

The tap room is fitted with tables and transverse seats, arranged section-wise. Longitudinal louver lights are placed at the lower edge of the ceiling. These shed light directly on the tables and about 50 per cent is spilled under the canary-yellow ceiling to produce a soft glow throughout the room. The ceiling air duct is made from Burgess perforated aluminum formed in an ornamental shape and trimmed at the bottom with a curved batten strip. This same arrangement is used throughout all the cars. The floor is covered with rubber of neutral brown closely matching the walnut trim.

Each of the luxury coaches has a 6-ft. women's lounge in one end, seating 5; a 49-ft. 8 in. coach section, seating 56, and an 11½ ft. men's lounge in the other end, seating 9. The individual reclining chairs, with backs which may be locked in any desired position, are upholstered in old rose and green velour in alternate cars. The ceilings are covered with aluminum leaf. The outside window sash are of extruded aluminum. The inside sash, however, are of walnut, and sealed to the outside sash by small gun-metal-finished locks. Louver-type lighting fixtures are located from each beam in the face of the continuous luggage racks in the coaches and parlor cars. Grilles in the face of the Holophane lenses serve to remove the edge glare from this type of fixture



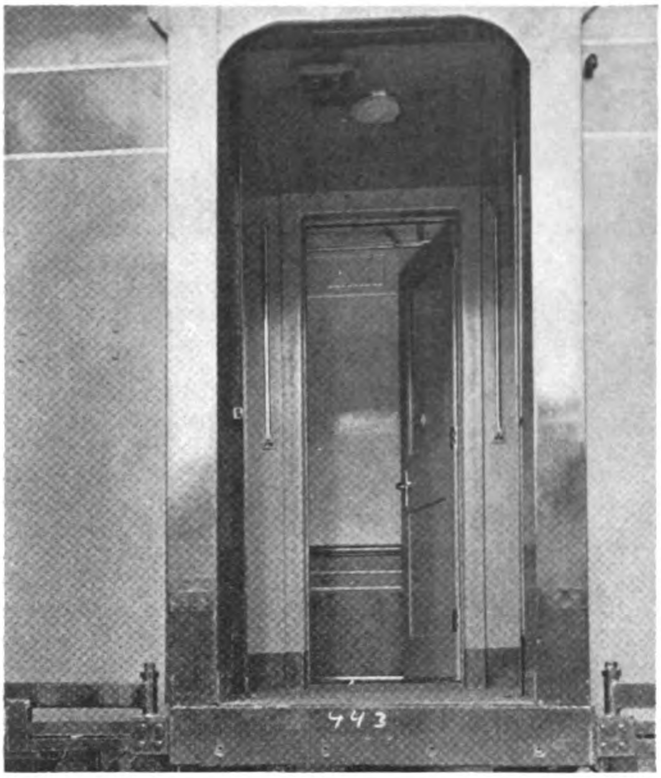
The truck, showing coil spring suspension, hydraulic shock absorber and levelizing bar

and play an important part in the decoration of the car.

The Dining Cars

The dining car, equipped with an 18-ft. 9-in. kitchen, a 9-ft. 6-in. pantry, and a 6-ft. refrigerator and linen locker section, has a cafe section 12 ft. 8 in. long which seats 16, and a main dining compartment 25 ft. 4½ in. long which seats 36, giving a total seating capacity of 52. This dining car is equipped with aluminum chairs. The dining-car tables are bracketed to the wall, making the dining-room floor completely accessible for cleaning without the obstruction of table legs. The rubber table tops are cream with inlaid brown stripes. A plain, modern buffet is installed at the kitchen bulkhead.

The walls and ceilings of the kitchen and pantry are covered with sanitary stainless steel. A new blower arrangement supplies cool filtered air in the kitchen and pantry. The conventional coal range is replaced by a modern hotel range designed to burn propane gas with resultant fuel saving and lower kitchen temperatures.



Vestibule door equipped with anti-pinch hinges—chromium-plated vestibule safety bars are shown locked in the raised position

Parlor and Observation Cars

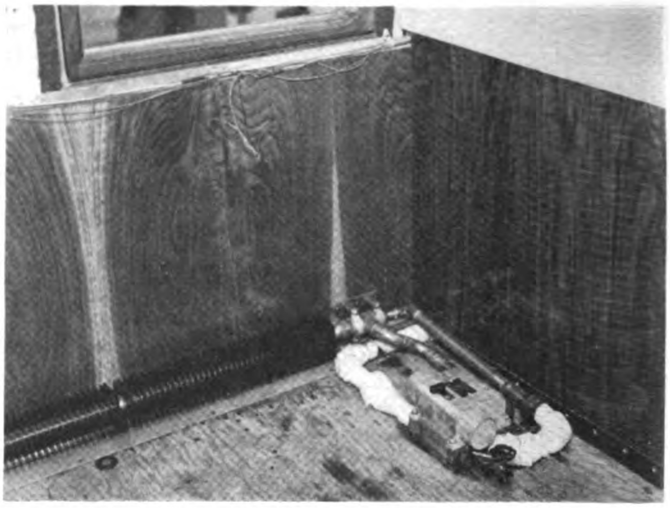
Each of the drawing-room parlor cars has a 6-ft. women's lounge in one end, seating 5; a main parlor section 44 ft. 4½ in. long, seating 24; a 6-ft. drawing room, seating 5, and a 7-ft. men's lounge in the other end, seating 5. The parlor car is equipped with luxuriously upholstered revolving reclining-back seats. A drop table is placed at each seat. In the drawing room a studio couch is quickly convertible into a bed and two pull-up chairs make the drawing room ideal for small parties desiring privacy.

The beaver-tail parlor-observation car has a 7-ft. lavatory section in one end; a 50-ft 8-in. main compartment or drawing-room section, seating 28, and an 18-ft. 3½-in. observation-lounge, seating 17. The observation-lounge, which is open to all parlor-car passengers, is separated from the chair section of the car by a partially glassed bulkhead. A wide sofa for three faces the rear. The exterior fins on the rear of the beaver-tail car add to the structural strength, and the horizontal fins shade the large sloping windows from the direct rays of the sun.

A new design of diaphragm enclosing the outer space between the car ends gives the train a smooth unbroken appearance and also serves to keep dust out of the vestibules. To further reduce air resistance underneath the train, retractable steps that are raised when the train is in motion have been installed at each vestibule. Hinged chromium-plated safety hand bars are available to passengers going through the vestibules from one car to another.

Exterior Treatment

In order to improve the outside appearance as well as to provide a cleaner-looking train when in service a re-arrangement of the two standard Milwaukee exterior colors—yellow and maroon—has been worked out for the new cars. In the Hiawatha cars built in 1934 there was a maroon letterboard and a maroon belt at the lower edge of the cars, with the sides finished in yellow. Thus the dark windows were emphasized in a background of light color which tended to make the windows look smaller than they actually are and to appear as single units rather than part of a continuous speedline panel. For the cars built in 1937 the side sheets were pressed to form continuous beading above and below the windows which effected some improvement by tying the windows together. In the new cars the yellow between the windows has been replaced by maroon, thus fitting the dark-appearing windows into a continuous panel of dark color along the sides of the train. To effect a lowering in the appearance of the sides of the cars the maroon bottom belt has been left off and the yellow field below the windows extended to the bottom of the car side. The gray of the roof contrasts effectively with the maroon color of the letterboard, tending to give the cars a long, low appearance.

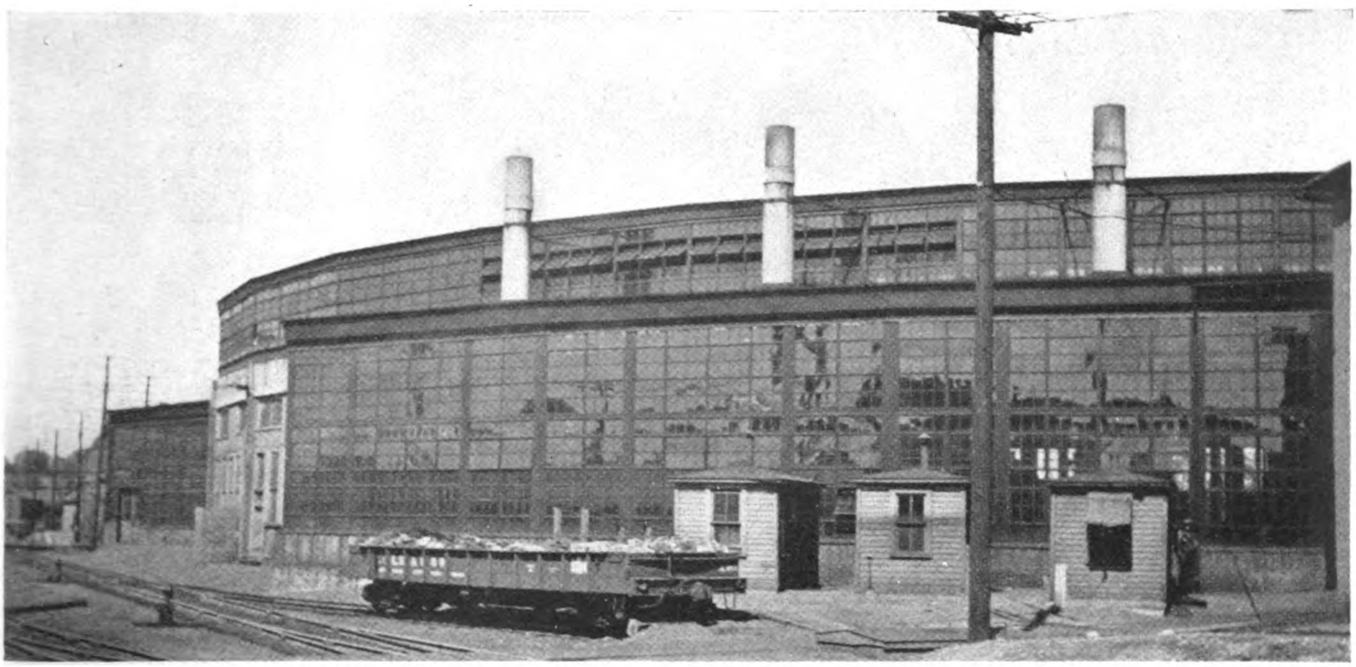


A section of the new Vapor copper-fin single-unit heating pipe and magnetic heat-control valve

Porthole windows are built in the sides of the express-tap-room cars. Windows of the same type have also been employed in the vestibule doors and in the toilets and passageways at the ends of the coaches and parlor cars opposite the vestibules.

Improved Facilities Feature

Modern B. & L. E. Enginehouse



Rebuilt B. & L. E. enginehouse at Greenville, Pa.

Better lighting, ventilation, more headroom, and improved facilities for making running repairs are included in the rebuilt Greenville enginehouse

During last year the Bessemer & Lake Erie rebuilt its enginehouse at Greenville, Pa., in order to provide better lighting, ventilation, more head room, and improved facilities for making running repairs to locomotives. The enginehouse, originally completed in 1911, was built of reenforced concrete and contained 17 stalls each 90 ft. long. At that time the stalls were of ample length to handle the power then in use, but the purchase of 2-10-4 type locomotives in recent years necessitated longer stalls.

The enginehouse is suitably located in the shop yard, both with reference to the work of servicing locomotives and to other shop buildings and facilities. It is situated so that ten stalls, six at the north end and four at the south end, could be extended without interfering with adjoining buildings and facilities. During 1937 these ten stalls were extended 27 ft. each, and diagonal or skewed walls were built where they adjoin the shorter stalls. During the recent building, the roof over the seven stalls not extended was rebuilt as a monitor and raised to the same height as that of the other ten stalls.

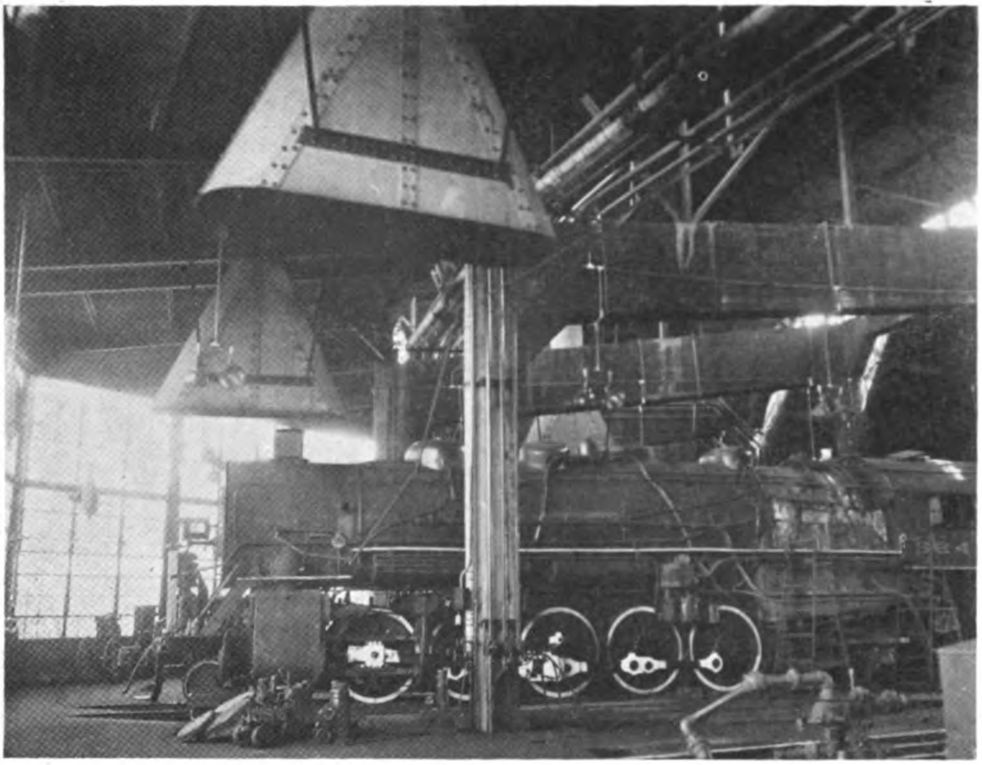
Layout of main steam and water pipes and electric conduits

The concrete roof, purlins, monitor, and rear curtain walls were removed from the old building but all radial concrete beams and columns were used for supporting the new construction which was built up on them and connected to the old concrete. The new construction is of welded steel. Continuous steel sash windows, to furnish ample lighting for the building during the day, were installed at the front of each stall and on both sides of the monitor. A continuous ventilating sash, manually operated from the floor, was provided in all stalls.

Lighting

The question of providing suitable lighting for the enlarged building was given very careful consideration. The lighting in the old building followed the common practice at the time the building was erected, but was now entirely inadequate. It was necessary to use hand torches and extension lines on dark days as well as at night. The decision was made to discard the ordinary practice and design an installation to suit the requirements of the enlarged building.

A comprehensive study including the size and shape



Smoke jacks with 12-ft. asbestos-board bells and 36-in. diameter stacks are used in the B. & L. E. Greenville enginehouse

of the building, stall layout, and the position of smoke jacks, pillars and jib cranes was made. Owing to the frequent presence of a smoke and steam ceiling, it was essential to keep the lighting units below this level so that the light would not be absorbed in this heavy atmosphere. The final decision was that, under the conditions, individual lights for each side of the locomotive would be required and each stall could be treated as an individual lighting problem, with angular lighting units directing light to the side of the locomotive rather than the conventional vertical mounted unit.

The corrosive atmosphere and the presence of sulphuric-acid fumes made it necessary to have a fixture especially designed for these conditions. The unit as finally designed is dust and moisture proof with all parts impervious to attack from the fumes.

The light required at the rear (towards the turntable) of the enginehouse is less than at the front. The stalls here are so close to one another that vertical-mounted units with the light directed to the floor, with special spread lens, were installed. The final spacing and focusing of the fixtures was definitely decided after a trial installation and the final layout made accordingly.

The wiring of the house and the hanging of the units have both been done in a unique and satisfactory manner. The units are mounted on hangers that are resilient to shocks and permit them to swing through a small arc in case they are bumped. The units focused angularly are mounted on tee-shaped conduit hangers with the bar of the tee nearest the floor; one lighting unit is mounted at each end of the bar and the two units on the bar are focused on locomotives in adjacent stalls.

The main power feeders to the house have been brought into a De-ion breaker panel board and the circuit feeders taken from there. The De-ion panel-board arrangement eliminates the necessity of fuses and prevents tampering. At the main panel board are four circuits used to control night lights, which are the first front lights in each stall and are kept lighted at night on account of the passageway around the stalls, which is kept open at all times.

The branch circuit switching for controlling the lights in each stall is located at the front column and is also De-ion breaker controlled. Every other rear column has a group of three breakers and the intermediate ones have four. The group of three breakers is so wired that one breaker will turn on three lights on the one side of the locomotive, a second breaker will turn on three lights on the one side of the locomotive in the adjacent stall, and the third breaker will turn on the two rear lights which are focused to the floor. The group of four breakers operate the same except that the fourth one is used to control a plug-in receptacle circuit for extension cords.

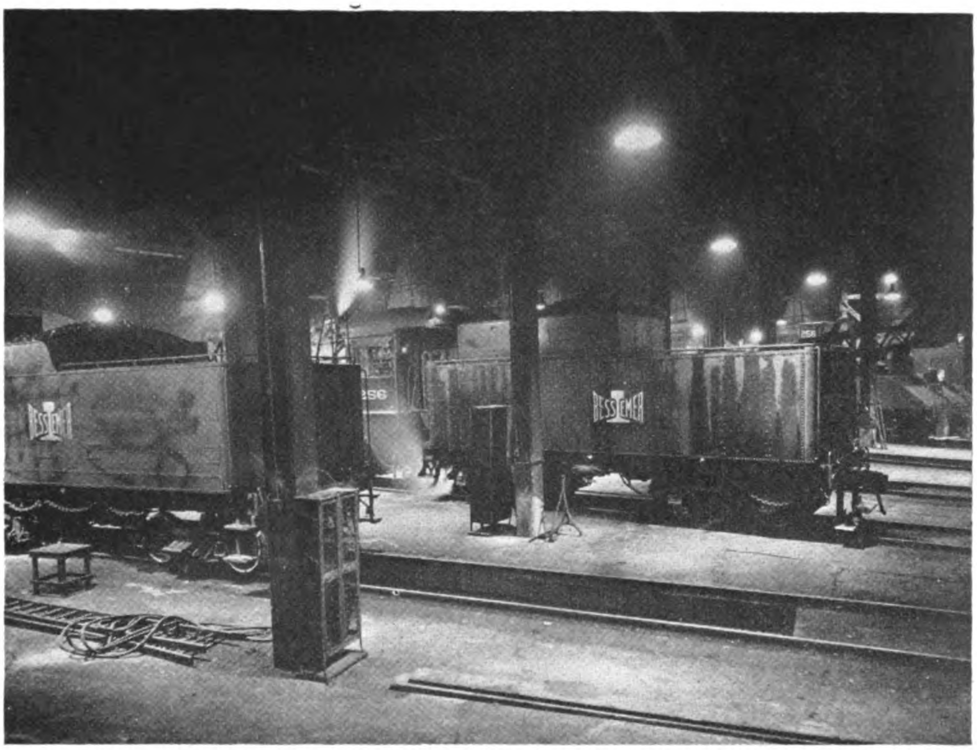
With this mounting and switching arrangement any particular part of a locomotive on which men happen to be working can be lighted, which results in economical operation and low maintenance.

All electric equipment and fixtures were furnished by the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., and installed under their general supervision by the railroad company forces.

Heating

The old concrete enginehouse was heated by an exhaust-steam system by means of pipe coils along all walls and by pipes on each side of the engine pits. The system was installed at the time the enginehouse was built. The exhaust steam was supplied from the power house by a large main in a conduit; various other buildings were supplied from the same main and the demand for steam was becoming in excess of the economical supply. The system was also becoming obsolete and was inadequate to care for any larger building, particularly one of the size and requirements of the enlarged enginehouse.

After a study of improved steam heating and other methods it was decided that a unit-blower heating system with live-steam supply, for the heating unit, would best meet the present requirements. The live steam at a pressure of 120 lb. is furnished by a main carried overhead around the front of the stalls. Steam is carried by branch pipes to each unit heater. Sixteen units, one between each two stalls, were installed. Each unit is a two-fan unit heater, supplying 6,200 cu. ft. per min. and is located about 5 ft. from front columns with the base 12 ft. above the floor. Each unit is separately con-



Each stall is treated as an individual lighting problem, with angular lighting units directing light to each side of the locomotive and with vertical units over the tender

nected and controlled by a hand-operated switch so that one or all can be working at any one time and temperature controlled as found necessary. The louvers in front of the heater are adjusted for height and location of the unit. Two heaters were installed for trial and later 14 more were added to complete the layout.

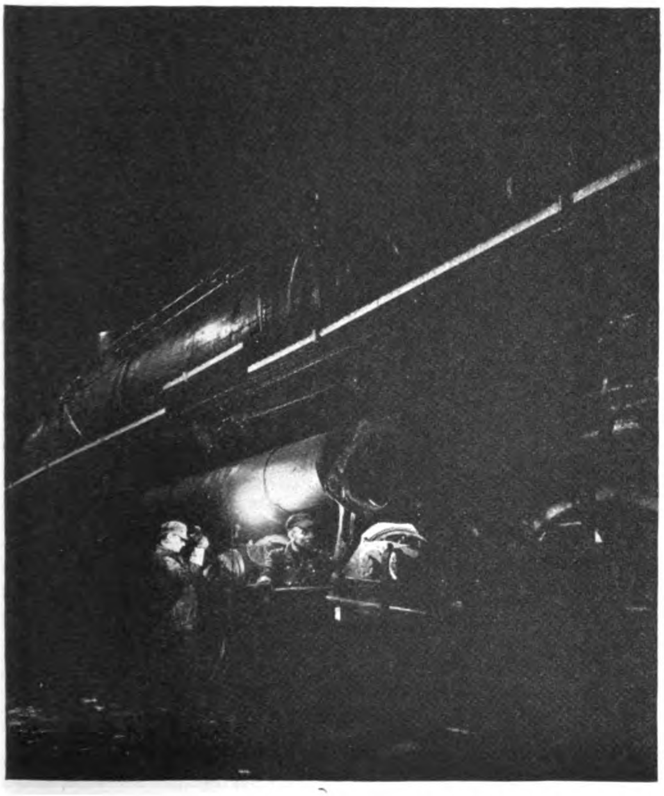
The old steam heating system, including the pipes in the pits and in the conduit at the front of the enginehouse, were entirely removed.

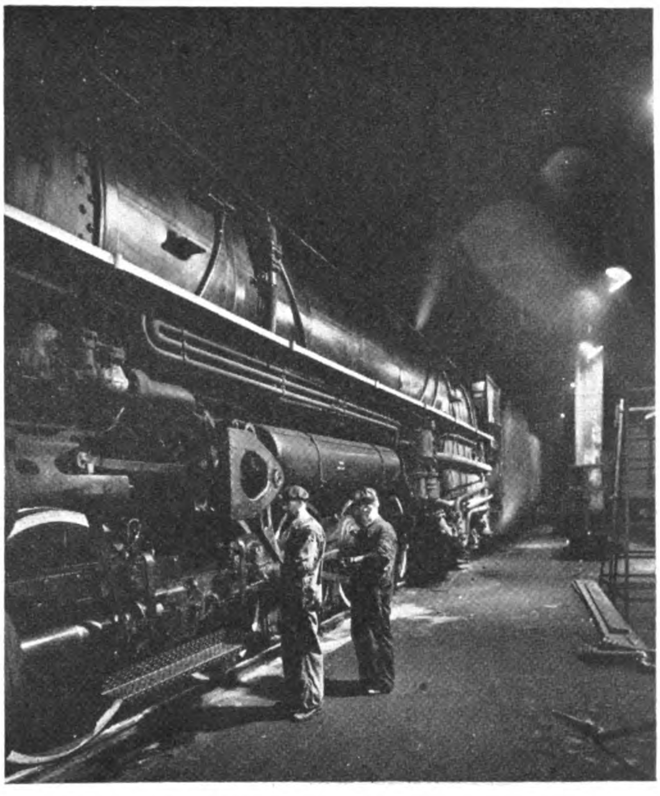
The heating units as finally installed were furnished by Ilg Electric Ventilating Company, Chicago.

Washout System

A locomotive washout and refilling system was installed at the time the enginehouse was built. The pump, tanks, and equipment were located in an annex adjoining the enginehouse on the south. The piping was carried in concrete conduits with connections for blowing off, washing out, and refilling locomotives furnished for each stall.

In 1937 the system was obsolete and inadequate for present conditions and for the larger locomotives now





Night views in the old and new B. & L. E. enginehouse

in use. In connection with the extension and enlargement of the enginehouse, the old facilities were retired and larger ones of latest design installed.

The new pumps and equipment are located in the room in the annex occupied by the former system, and the washout and refilling tank placed just outside of that building. All piping is carried overhead to the enginehouse and overhead on hangers around the front of stalls. Connections are taken from these overhead pipes, carried to the columns and down the columns to supply each stall. The system was furnished and installed by the F. W. Miller Heating Company, Chicago. Company forces removed the old plant, installed all foundations, the pipe carriers in the enginehouse, and prepared the layout for the actual installation.

Smoke Jacks

The smoke jacks in the old building, put in when the building was erected, were all double, consisting of two jacks each with a bell 10 ft. long joined at the ends and covering 20 ft. of the stall. Twelve pairs were of asbestos board and five pairs were of cast iron. These were all in need of replacement and were taken out and new single jacks, each with a bell 12 ft. long, and with a 36-in. diameter circular stack, were installed. The bells are of asbestos board and the stack of Transite pipe. The jacks, including the stack, were furnished by Johns-Manville Corporation.

General

All piping in the building is carried overhead, the main pipes of all kinds being on the hangers near the front of the building. This new arrangement permitted the removal of the old pipes which were all carried in the conduit at the rear of the building, and the conduit will now be used exclusively for drainage purposes. All new piping is welded at all joints and connections. Electric conduits and wiring are also overhead, the main conduit being supported on the hangers which also carry the other pipes.

A new hard surface floor, built up on a crushed-stone base with a prepared asphalt concrete top, was laid for the entire building. This will provide a floor comfortable for the men to work on and at the same time provide for easy handling and operation of trucks and movable cranes and machines. The entire project, including both design and construction work, was carried out by the railroad company employees under the direction of the chief engineer.

Serviceability of Heavy-Duty Pistons

(Continued from page 94)

found unsatisfactory in the smaller size might be much more successful in the 5½-in. size.

The authors are not satisfied that differences in service life, where the rods wore to the limit, obtained with the different kinds of steel is related directly to the wear resistance in each case. Certainly the results have not been consistent with what might be expected from other experiences with these materials. Possibly some unsuspected changes in the lubrication or priming and foaming of the boiler have produced conditions unfavorable to the development of maximum life.

The rather low ductility of the quenched-and-tempered steel is not believed to be detrimental. Rigidity, or stiffness, appears to be the property that is essential to meet the operating conditions where these rods are used. The fracture at a relatively short life of the rods with high ductility seems to bear this out. The soft rods flex more than the hard ones and the fatigue strength is exceeded at such frequent intervals that cracks soon develop. It is also possible that with the hard rods a larger portion of the stress is transferred into the crosshead through yielding of the lower strength steel of the crosshead.

Slipping Tests of Steam Locomotives

(Continued from page 90)

lb. The play between the rail and tie plate as well as the rail depression was measured. Recommended practice followed in this procedure is given in the Proceedings of the A. R. E. A., Vol. 35, page 294. The values of the modulus were found to vary from 1,060 lb. to 3,460 lb. per in. per in.

[Note—The results and a discussion of the slipping tests will be included in Part II of this paper which will appear in the April issue. The text of Part I includes only a general discussion of the background leading up to the tests, a description of the preparations for making the tests and a presentation of the basic data concerning the locomotive tested. Included in Part I are a set of four pictures made from the 400-frame-per-second motion pictures showing the main driving wheel as it approached the maximum of ⅞-in. off the rail. There are also six charts covering the 4-6-4 type locomotives. Reference to these and similar charts covering the 4-8-4 and 2-10-4 type locomotives will appear in Part II.—EDITOR.]

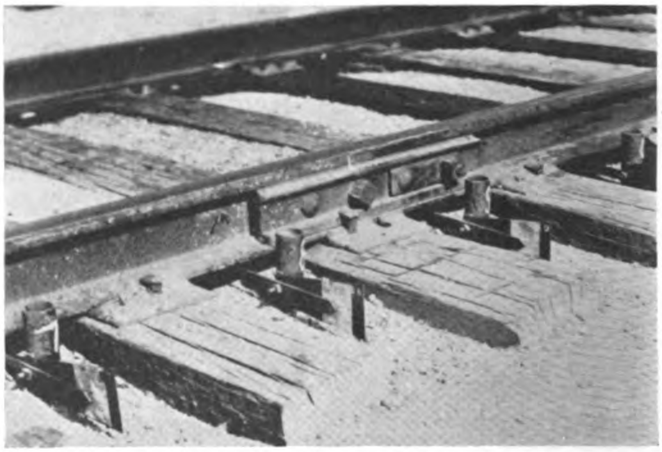


Fig. 12—Lever-type rail deflection gage

BURLINGTON'S NINTH ZEPHYR NAMED "GENERAL PERSHING."—The ninth "Zephyr" of the Chicago, Burlington & Quincy, which will be placed in service between St. Louis, Mo., and Kansas City early in April, will be named the "General Pershing," in honor of one of Missouri's most illustrious sons. The commander of the American Expeditionary Forces was born near Laclede, Mo., on September 13, 1860. His father was John F. Pershing, a section foreman on the Hannibal & St. Joe (now part of the Burlington). In addition to carrying the name, "General Pershing Zephyr," on the front, the four cars will be named the "Silver Charger," the "Silver Leaf," the "Silver Eagle" and the "Silver Star." The General Pershing will team with the Mark Twain, also named after a Missourian, Samuel L. Clemens, in a double daily operation between St. Louis and Kansas City. In addition the new train will provide accommodations for passengers between St. Louis and Denver, Colo. The order for this train was announced in the October, 1938, *Railway Mechanical Engineer.*

EDITORIALS

A Boiler Problem

One of the problems which causes the greatest tax on the ingenuity of those employees on the railroad who are concerned with locomotive boiler design or maintenance is the patching of boiler sheets. Many patches, if not exactly alike, are so nearly alike as to be dealt with in a more or less routine manner. However, occasionally a patch is required at a location which creates a real problem, either in the design of the patch or in its application, or both, the solution of which draws upon all of the knowledge, skill and ingenuity of every one who has anything to do with it.

Do you recall any interesting cases of this kind with which you have had to deal? The *Railway Mechanical Engineer* offers two prizes for concise articles describing the most interesting problems of this kind submitted to us on or before May 15—a first prize of $30 and a second prize of $20. The article must describe a patch which has actually been installed on a locomotive and which is known to be designed with adequate efficiency. The unusual conditions which had to be met should be clearly set forth including either interesting methods of application or of patch design, or of both, as the case may be. In picking the prize winners, the articles will be judged not on the quality of the English composition, but on the interesting character of the problem and the way in which it was worked out.

The text of the article should be accompanied by sketches or photographs, or both, if available and necessary. Keep the text as short as clearness will permit.

All articles submitted will become the property of the *Railway Mechanical Engineer*. Those other than prize winners which are published will be paid for at regular space rates.

Forced Vibrations In Locomotive Operation

Elsewhere in this issue appears the first part of a paper by T. V. Buckwalter and O. J. Horger before the February meeting of the New York Railroad Club in which are set forth the results of some very interesting and significant steam locomotive slipping tests. These tests deal with the phenomena of the jumping main driving wheels which have been encountered on several steam locomotives designed for high-speed operation when slipping at high speeds.

For many years occasional locomotives with badly balanced driving wheels have been the cause of track damage when operating at high speeds. In these cases, however, the distance between the location of rail kinks coincided with the circumference of the wheel and they occurred at speeds sufficient to develop a dynamic augment greater than the wheel load. In the case of the new phenomena, however, the jumping occurs at speeds lower than would be required for the lifting of the wheel under the influence of the dynamic augment of the overbalance alone and has occurred while the locomotive was slipping at high speeds.

The tests described by Mr. Buckwalter in his appearance before the New York Railroad Club have involved an interesting application of motion picture photography and are correlated with a mathematical analysis of the forces involved on the assumption that the lifting of the wheel is the result of the forced vibrations. The factors are wheel and crankpin diameters, total weight at the rail under the main drivers, the unsprung weight, the overbalance, the stiffness of the driving spring, and the stiffness of the track considered as an elastic foundation. It is interesting and gratifying to note that the calculated speed at which the driving wheel begins to lift checks very closely with the results observed in the slipping tests. All of the factors in the calculation pertaining to the locomotive are readily available. The stiffness factor, or modulus of elasticity of the track, is not difficult to obtain. A method has been developed by the American Railway Engineering Association which, in effect, gives a factor expressed in essentially the same terms as are used in the measurement of spring stiffness. Essentially, it is the load on the track in pounds per inch of net rail deflection for each inch of rail length.

It is not many years since the field of periodic vibrations in machinery and structures has been brought within the range of mathematical analysis. At about the same time, increasing train speeds began to cause the development of vibratory phenomena, in connection with passenger cars, some of which have been of a very disturbing character. When passenger-train running speeds began to exceed 70 and 80 miles an hour, trucks which were formerly smooth performers began to do snake dances down the track. This has again raised the question of the coned wheel vs. the cylindrical wheel. On light cars the replacement of the former with the latter has corrected the difficulty, indicating that the periodicity of a truck with cylindrical wheels is at least different from that of the same truck with coned wheels. In freight-car trucks the same basic problem has been encountered in connection with helical bolster springs, and a number of devices for damping the tendency toward periodicity at critical speeds have been applied in service. Now, it is clear that somewhat similar phenomena are being encountered with respect to the main drivers when rotating at sufficiently high speeds.

Not only is it encouraging to know that the probable

speed at which such a result may be expected in any given locomotive on a track of known stiffness can be predicted with reasonable accuracy, but also that the problem of designing for high steam locomotive speeds involves no mysterious factors with which we are not already capable of dealing. To deal with it satisfactorily, however, will involve further refinements in methods of counterbalancing. It will also involve the closest attention to the reduction in the weight of reciprocating parts and the lightest overbalance which can be used without causing undue disturbance to the riding of the locomotive.

The paper in question is of such importance that it is being published in full. The concluding instalment will appear next month.

Training the Railway Employees

The railway officer has, as one of his problems, the training of men to fill positions of responsibility. He has to develop the capacity of men, coming from the ranks, so that they are broadened to carry the responsibilities that go hand in hand with the administration of the affairs of which they are to have control. In addition to this, he must meet a condition which is growing rapidly, necessitating a broader training for the men in the ranks. The corporation and its employees have, as a result of the growth and size of organizations, grown apart, and plans through which a better understanding and a more sympathetic feeling can be introduced, seem desirable and necessary.

In the case of the individual there seems to be a demand for a training better and more thorough than that which is the usual course followed by the men coming from the ranks. It frequently happens that a man is selected and put into a position without having had any previous knowledge of such an action on the part of his superiors and with no coaching. He frequently fills the position in which he is placed, broadening the best he can with his own efforts, as he goes along, carrying the responsibilities of his position with all the work attached to it, and with no particular well defined scheme in which he can prepare himself for higher efficiency and greater responsibilities.

Only recently there appeared in one of the railway papers the question: "Why do not young men with a college training remain in the railway service?" This question has often been discussed, and while the railways have retained a large number of college men, it is true that a good many capable men who have obtained a college training have entered the railway service, only to give it up after they have surveyed the field of their future employment. They have realized the odds against which they have to work, and the future in store for them, which is their probable compensation for the years of toil they would have to serve to reach the end. These men have found other lines giving them greater opportunities for development and higher rewards for ability and energy. The man who has not had the opportunity of the college graduate but has the same ambition to do things and develop to his maximum capacity, when he comes from the ranks, has had to accept the handicap where the college man has been able to get away from it.

The opportunity of developing capacity through habit of thought should be given the man long before he leaves the ranks. Judgment develops with practice, it is true, but it is surer when the habit of thought has been directed along the right lines. It is, therefore, a safe plan to pick out the man in the ranks, guiding him possibly long before he is needed for a position of higher responsibility. He should be given an opportunity to adjust his view point while he is still in the ranks. When he finally reaches the first step beyond the ranks and becomes a foreman, a trainmaster or has a position of a similar nature, there is a possibility of developing his capacity beyond what it will be by confining him strictly to his responsibilities and duties, if he is taken into the confidence of his superiors, by being given an insight into the work beyond his daily tasks, or in other words, if he is schooled to have an insight into larger problems that will broaden his usefulness and prepare him for the future.

[The above remarks are especially appropriate today, although first expressed October 21, 1913, over 25 years ago in a paper presented before the Western Railway Club at Chicago. The author was A. R. Kipp, at that time mechanical superintendent of the Soo Line.—Editor]

Progressive Light Repairs

The progressive system, or straight-line method of production originally developed in the automotive industry, was first applied to railway equipment in the construction of new freight cars in the builders' plants. In the course of time, the merits of this system became apparent to railway car-department officers, who also were under heavy pressure to reduce costs, and they said "Why can't we systematize and organize our heavy car-repair work in such a way that it will be divided into a limited number of major repetitive operations, performed one after the other at certain designated spots where men, materials and tools can be concentrated and the work done quickly and efficiently as the cars pass each spot?"

This extension of the progressive system to program car repair work also proved highly successful and netted the railroads many thousands, if not in fact, millions of dollars in the aggregate over the ensuing years. The practicability of the plan hinged, of course, upon balancing the work and the force of men at each position so that approximately the same time element was in-

volved and at a given signal, all the cars in the line could be moved from one position to the next. The advantages of specialized men, efficient tools and the saving of lost motion in handling material, are supplemented by a healthy competition between the gangs at the various positions or spots, all of whom must complete their work within the given time interval or be subject to good-natured joshing by their fellow car men.

In the field of heavy locomotive repair work there was little opportunity for use of the progressive system in most transverse shops, where each locomotive, received for repairs, was placed on a pit track, stripped, unwheeled, overhauled, rewheeled and finished ready for testing in that one position. With the advent of the longitudinal-type shop, however, it proved feasible to strip each locomotive at one point on the incoming center track where it was unwheeled, subsequently moved to a diagonal side pit for complete overhauling, and finally rewheeled at the outgoing end of the center track where all finishing operations were performed. The application of the progressive system to departmental work in all modern locomotive repair shops is, of course, a demonstrated success, the repair of such fundamental parts as driving wheels and boxes, motion work, spring and brake rigging, superheater units, power reverse gears, air-brake equipment, etc., lending itself well to handling on a production basis.

Owing to the widely varying time element in light repair work, it was formerly believed by responsible railway officers that the progressive system offered little opportunity for adaptation in this field of maintenance activity. Even this last stronghold of unorganized, relatively inefficient and "catch as catch can" methods is now being invaded by the carefully planned progressive system, which is now being installed by the Illinois Central, for example, at all major car repair points as described in an article elsewhere in this issue. The major operations, such as jacking cars for wheel changes, repairing trucks, renewing defective couplers and draft gears, repacking journals, cleaning air brakes, repairing leaky roofs, sides and doors, etc., are all performed in orderly sequence by men who specialize in the respective kinds of work and are provided with the tools and materials needed for its efficient handling.

By the location of jacking equipment and necessary hoists at one point where all truck repair work is concentrated and performed as the cars pass this point, it is no longer necessary to move heavy jacks, horses and truck-repair cranes all over the car-repair yard. The location of journal packing and air-brake cleaning are more or less flexible, owing to the relatively light weight of tools required for this work. All steel work which involves the driving of hot rivets, however, it is especially desirable to concentrate as nearly as possible at one point and thus avoid the necessity of moving heavy rivet forges about the yard or using the common, but highly inefficient and unsatisfactory method of heating rivets with the oxy-acetylene torch.

To a certain degree at least, the advantages of the progressive system may seem to be effective in light car-repair work. To what extent will be determined by the progress of this activity on the Illinois Central and other roads which will be watched with interest.

New Books

THE WELDING ENCYCLOPEDIA. *Ninth edition. Published by the Welding Engineer Publishing Co., 608 S. Dearborn street, Chicago. 696 pages, 5⅝ in. by 8¾ in. Price, $5.*

The Welding Encyclopedia is a reference book on metallic arc, carbon arc, oxy-acetylene, electric spot, butt, flash and resistance welding, thermit welding, and metal spraying, presented as a practical treatise to supplement engineering text books and publications currently available. A large part of the ninth edition has been completely rewritten, particularly the sections dealing with arc welding. Subject matter is arranged in alphabetical order, as in a dictionary or telephone book, the need for consulting an index thus being eliminated. In addition to the usual list of trade names, company names have been inserted alphabetically with a full listing of trade names in each case. Although the book contains considerable engineering data, less emphasis has been placed on the purely technical and research aspects of welding for the purpose of making the information of maximum value to the practical man in the shop or out in the firing line in the field.

RAILWAY FUEL & TRAVELING ENGINEERS' PROCEEDINGS. *Published by the association; bound in imitation leather and comprising 268 pages, 6 in. by 9 in. C. Duff Smith, secretary-treasurer, 1255 Old Colony building, Chicago. Price $2.*

This book contains the official Proceedings of the second annual meeting of the Railway Fuel & Traveling Engineers' Association held at the Hotel Sherman, Chicago, September 27 and 28, 1938. In addition to the opening address by President J. C. Lewis, road foreman of engines, Richmond, Fredericksburg & Potomac, the book contains addresses by John Hall, chief inspector, Bureau of Locomotive Inspection; C. F. Richardson, West Kentucky Coal Company and Roy V. Wright, editor, *Railway Mechanical Engineer,* and committee reports on ten subjects pertaining to the more efficient preparation, distribution and use of railway fuel, and four special papers presented by authorities on various phases of the same subjects. The book is logically arranged, clearly printed and easily readable. Individual discussions of the subject matter included in the various committee reports and special papers also present much additional information of importance.

With the Car Foremen and Inspectors

Progressive System of

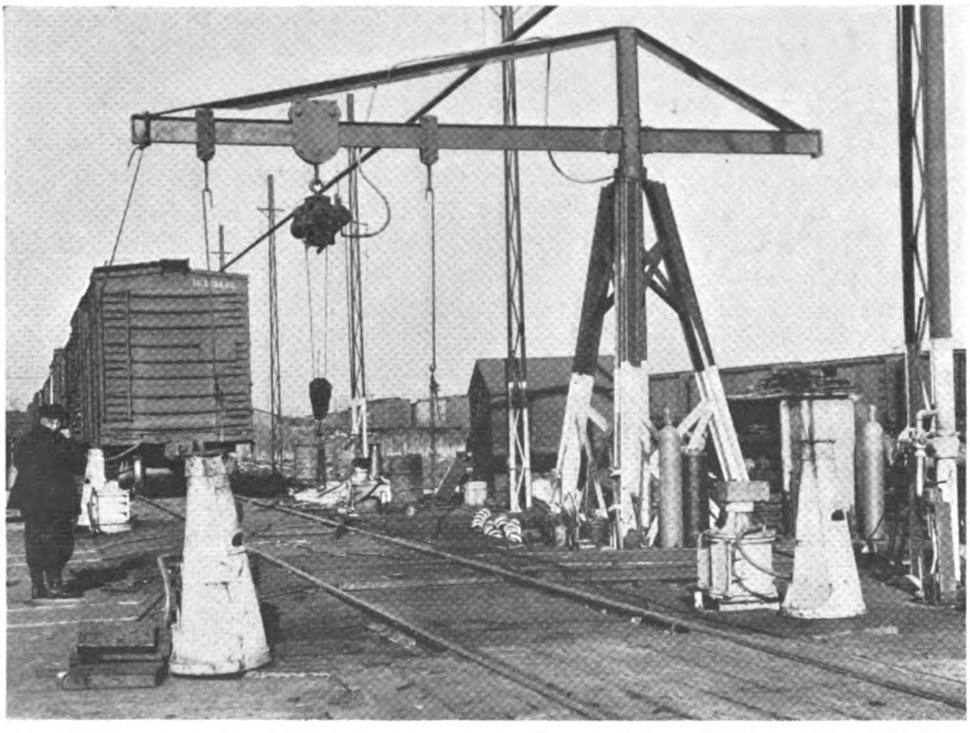
Light Repairs on the I. C.

LIKE many other roads, the Illinois Central has applied successfully the progressive or spot system of freight-car repairs to heavy repair operations at all major points where program work is carried on. This system, modified to a certain extent to suit local conditions, is now being applied with equal success to the work at light-repair tracks where the older method of spotting cars and moving men and repair materials to the cars was formerly employed.

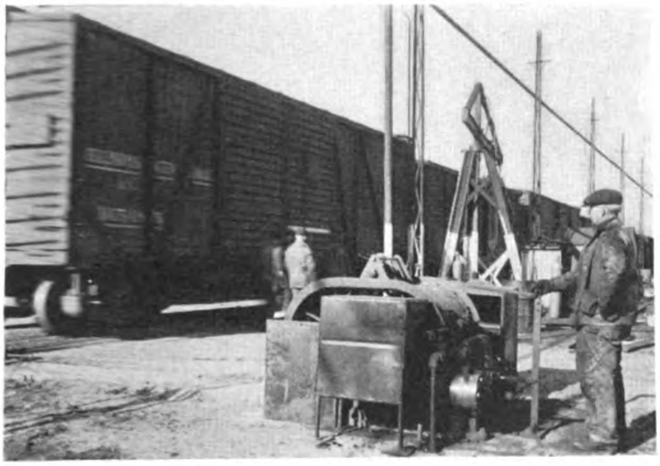
For example, at the I. C. car repair yard at Markham, Ill., an average of 85 bad-order cars a day are classified at the hump and switched to the south end of Track 8 where they are placed without further cutting or spotting, within reach of a power-operated pulling cable. On the average, 32 of these 85 cars a day require truck work, including 16 wheel changes. The balance are sent to the repair track for air-brake work, repacking of journal boxes, renewal of defective couplers or draft gears, and repairing raked siding, leaky doors, roofs and other parts of the car structures.

Both loaded and empty bad order cars are received at the Markham yard repair track, where a minimum force of men is located and provided with special tools, equipment and materials necessary in making all kinds of light repairs. In general, the men are specialists at their respective jobs and each group works at one position on the repair track where necessary tools and materials are provided in advance, and all operations can be performed with minimum delay and also with minimum physical effort by car men, thus tending to assure maximum production per man-hour. Truck work, for instance, which constitutes by far the heaviest part of light repair operations, is concentrated at a single point on the repair track and the cars are therefore, in effect, brought to the repair men, instead of sending the men with their tools and materials to the cars, wherever they may be spotted about the yard. This, of course, is the essence of the progressive system as applied to car repairs.

With a four-man crew, 124 man-minutes or 31 actual minutes per truck is the average time required at the truck repair position, which means that the present capacity of the track is approximately 16 trucks, or 8 cars requiring repairs to both trucks per day. In case only one truck per car is in need of repairs, 16 cars can be handled per day. Any necessary coupler or draft



Car jacking equipment, and swinging crane with hoists used at the truck-repair position at Markham yard



Air-operated hoisting engine and cable, as used in moving cars up to and past the truck repair position

gear replacements are made at this position while the cars are jacked up, and the cars then move north on the repair track where necessary air-brake and other work is done. Cars are pulled twice a day from the north end of the track so that they can be made up in trains and proceed to destination with no more delay than is absolutely necessary.

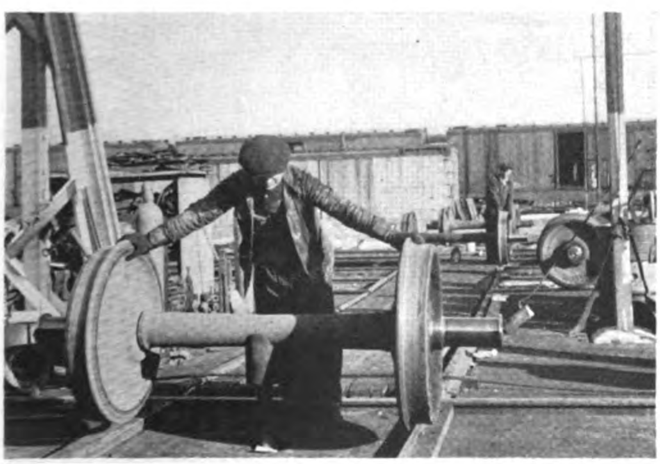
Description of Equipment Used in Truck Repairs

Special equipment supplied at the truck repair position includes four powerful air jacks and four metal horses; a rugged overhead swinging crane, equipped with two Coffing hoists and one Little Giant 2-ton pneumatic hoist for lifting the truck parts; suitable cross tracks and wheel-storage tracks with air-cylinders mounted in the ground at each intersection to permit raising and turning wheels easily without the use of wheels sticks; suitable material storage racks and tool house; and an air-operated hoisting engine, equipped with a 7/8-in. steel cable and hook operating through two 12-in. sheave wheels to pull cars in either direction past the truck-repair position. The main air supply is from a welded 4-in. overhead air line which carries about 100 lb. pressure, and this line, as well as underground cross lines, have been remarkably free from leaks and condensation difficulties since their installation several years ago. During winter months, these air lines are blown out at the conclusion of each day's work to make sure that no moisture will be left in the pipes and cause trouble by freezing.

The most striking feature of the truck-repair equipment at Markham yard is the substantial swinging crane which may be turned parallel with the tracks when not in use or swung out over the truck repair position when needed in dismantling or reassembling trucks. This swinging crane consists of an 8-in. horizontal I-beam, or boom, extending 16 ft. on one side of the vertical supporting member, or mast, and 6 ft. on the other side for use if necessary in lifting heavy materials on the opposite track. The three hoists are supported on rollers and, of course, easily moved to any desired position on the boom. The boom is riveted to the mast at an elevation of 11½ ft. above the ground and the outer ends are supported by 4-in. steel angle braces. The mast, consisting of two 8-in. channels placed back to back and stiffened with steel reinforcing strips welded in place between the flanges, is supported and revolves in a heavy steel tripod structure, also made of 8-in. channels, well braced and mounted on a substantial concrete base.

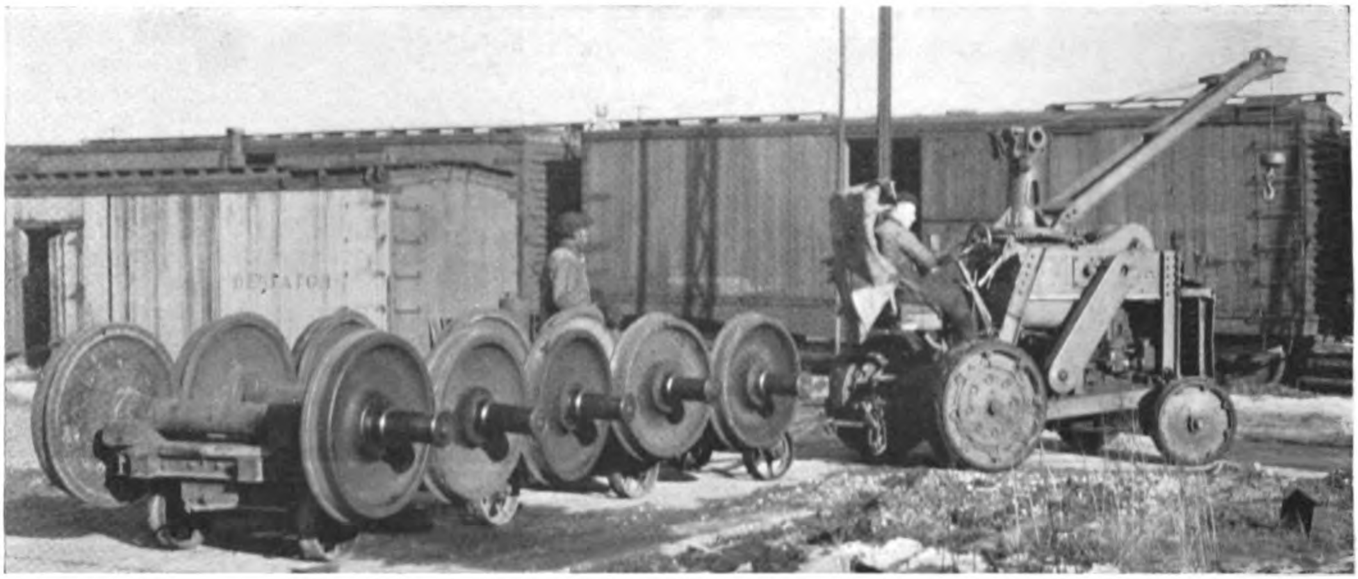
The weight of the swinging boom and mast is carried on two jack ball bearings, one at the top support and the other at the bottom, thus assuring easy turning of the boom. In accordance with the usual practice the two outer manually operated hoists are used in raising and lowering truck side frames and the center air hoist supports the bolster while the side frames, spring plank, brake beams, etc., are being adjusted to the proper position. The resultant saving in time and labor makes this device a valuable adjunct to the truck repair job.

Possibly not quite as spectacular, but of almost equal importance with the swinging crane, from the point of view of labor saving, is the powerful pneumatic equipment supplied for jacking cars. This equipment consists of four 18-in. passenger-car brake cylinders, located for convenience, one pair on either side of the truck repair position, and arranged so that each pair is operated simultaneously by one air valve, placed conveniently on one of the vertical pipes connected to the 4-in. overhead air line. These air cylinders are permanently mounted on short channel sections which have 24 in. of guided cross travel on rails imbedded in concrete, a construction which permits easily sliding the cylinders out of the way so that they are entirely in the clear when moving a cut of cars over the track. When a car has been jacked up at one or both ends, substantial iron horses 44 in. high and 24 in. in diameter at the base are used to support the weight of the car body while repair work is progressing on the trucks. These iron horses, constructed as shown in the illustrations and resting on concrete foundations, are designed to support heavily loaded cars with a substantial factor of safety.



Cross track along which wheels are moved from the storage tracks to the truck repair position

Lightweight pan which is easily portable and serves effectively to keep journal packing off the ground



Loadmaster and trailers used in handling wheels to and from the car wheel shop

One of the illustrations shows the cross track and air-cylinder wheel-lifting and turning device used in handling car wheels. A wheel-storage area adjacent to the truck-repair position is equipped with four storage tracks having a capacity of 25 pairs of wheels per track. These tracks are all parallel to the main repair track and an 8-in. air cylinder, set in the ground at each intersection, provides full flexibility in moving any desired pair of wheels from one of the storage tracks to the truck-repair position. A short 6-in. pipe section, with a half-cylindrical recess across the top to keep the car axle from rolling off, is not permanently attached to the air-cylinder piston but may be easily removed when necessary so that the piston, in the lowered position, will be flush with the ground and offer no interference to movement of a truck equipped with brake beams and spring plank over the track.

Worn car wheels, removed at the truck-repair position, are taken to the wheel shop for reconditioning by means of a Loadmaster and two trailers, each of which is equipped to carry three pairs of wheels if necessary. The trailers are of the conventional steel-frame type, with wood tops and positioning blocks to keep the car wheels in proper alinement. The Loadmaster is an efficient tool which serves not only as a tractor but is equipped with a boom for lifting various materials which must be handled to and from the repair track. In general, all truck materials such as wheels and axles, bolsters, side frames, spring planks, brake beams, journal boxes, springs, spring seats, etc., are located adjacent to the truck repair position where they can be secured without lost time or the expenditure of much physical effort on the part of the truck-repair men.

Four men are used at the truck-repair position, two on each side, which experience has shown to be an efficient arrangement. Two of the men work on brake beams, brake rigging, etc; the other two are responsible for journal bearings, wedges, springs, spring caps, etc.

A lightweight and unusually satisfactory container or pan for use in repacking a journal box is shown in another of the illustrations. This pan is shallow and made from one end of a paint container which would otherwise be scrapped. A few holes are drilled near the top for insertion of a hook by which to pull the pan over the ground. The use of this device keeps the waste off the ground and hence avoids the possibility of contaminating it with dirt and cinders which increases the difficulty of reclaiming the packing.

Progressive System Used at Other Light Repair Points

The progressive system of working light-repair cars, described in this article, is also used on the Illinois Central at Centralia, Ill., East St. Louis, Ill., Paducah, Ky., Memphis, Tenn., and McComb, Miss., and at present the system is being installed at Louisville, Ky., Birmingham, Ala., and Council Bluffs, Iowa.

The method at some of these points varies in certain details. For example, in some instances, there is a wheel-loading track alongside of the truck-repair position, which permits loading wheels without the use of a Loadmaster or tractor service, and this results in some saving of cost.

At several of the points, from two to four tracks are used for truck repairs, the positions being parallel on all tracks. Some arrangement of this sort will also be installed at Markham in the near future, owing to the fact that occasionally more cars are received requiring wheel changes than can readily be handled at one position.

The rigidly constructed swinging crane and hoist equipment in use during the dismantling of a truck

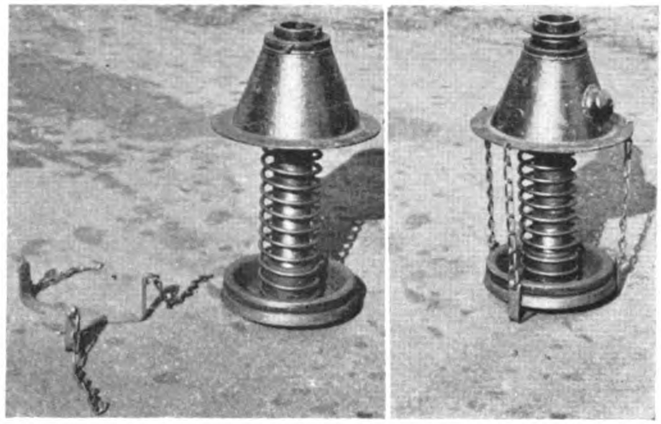
Two Air Brake Devices

Two relatively simple devices for expediting air-brake repair work at the Dupo, Ill., car shops of the Missouri Pacific are shown in the illustrations. The first view illustrates a device designed to hold the non-pressure head of a Type AB brake cylinder against spring pressure while the collar is being removed when necessary to remove the non-pressure head for any reason. The device consists simply of a circular steel base piece to which are welded three small angles made of ¼-in. by 1-in. steel, with the upper ends forged to an eye-shape for connection to short pieces of fire-door chain. The upper link of each chain is opened to form a hook, as shown at the left. This bracket is placed on the ground and the piston set in the bracket in such a way that the non-pressure head can be pushed down about one inch and held in place against spring pressure by attachment of

Triple-valve storage rack and a pneumatic device for cleaning triple-valve gasket faces

the hooks, as illustrated at the right. The piston collar and the three bronze rings can then be readily removed in case they need replacement. If other work necessitates, the three chains can then be unhooked and the entire piston, push rod, spring and non-pressure head disconnected.

A convenient triple-valve rack and a quick and sure method of cleaning triple-valve faces so that there is practically no chance of their leaking when reapplied with new gaskets is shown in the second illustration. This triple-valve facing device consists of a 6-in. square block of wood 1½ in. thick which is bored and equipped with a 3-in. steel bushing to fit down over the triple-valve center boss. This block, equipped with two No. 50 grit emery-cloth strips, 2½ in. wide, on the lower surface, is supported and hinged in a steel bracket made of ⅜-in. by 1½-in. stock, braced with a small tie rod at the center and having a welded taper spindle at the top which engages the shank of a small air motor. A few turns of this motor under such small pressure as may be necessary, suffices to clean the face of the triple valve thoroughly of rust, dirt and any small pieces of gasket



Angle bracket and chain arrangement used in removing the non-pressure head of a Type AB brake cylinder

rubber which may adhere to it, thus assuring a tight job when the triple valve is reapplied with a new gasket.

The triple-valve face could, of course, be cleaned by hand at the bench using an ordinary piece of emery cloth but this would take more time and, in fact, be a less satisfactory job than can be obtained with the simple device illustrated.

Questions and Answers On the AB Brake

Miscellaneous

374—*Q.—What is the weight of the complete AB equipment?* A.—585 lb.

375—*Q.—What is the weight of the service portion?* A.—51 lb.

376—*Q.—What is the weight of the emergency portion?* A.—52½ lb.

377—*Q.—What is the weight of the mounting bracket?* A.—68 lb.

378—*Q.—What is the weight of the brake cylinder?* A.—169 lb. with lever bracket; 157½ lb. with the plain pressure head.

379—*Q.—What is the weight of the combined auxiliary and emergency reservoir?* A.—255 lb.

380—*Q.—What is the weight of the separate emergency reservoir?* A.—Approximately 160 lb.

381—*Q.—What is the minimum brake-cylinder pressure obtainable with a brake application in a solid AB train?* A.—10 lb.

382—*Q.—What is meant by the expression: "Transmission rate in feet per second?"* A.—The length of the main brake pipe between the front and the rear cars is divided by the number of seconds between the outward movement of the brake-cylinder piston on the front and the rear car, the result being so many feet per second.

383—*Q.—Does the transmission rate change in proportion to the length of the brake pipe?* A.—The emergency transmission rate is practically the same, but the

service transmission rate changes with the length of the train, the length of the brake pipe, etc., to some extent.

384—*Q.—Based upon rack data, what is the service transmission rate?* A.—Approximately 475 ft. per sec.

385—*Q.—How does this compare with the K equipment?* A.—With the K equipment the rate is approximately 90 ft. per sec. with brake-pipe leakage, and varies materially with the length of the train and the brake-pipe leakage.

386—*Q.—What is the brake release time from 50 to 5 lb.?* A.—22 sec.

387—*Q.—How does this compare with the K equipment?* A.—Normal release with the K equipment is 6 sec., and retarded release is 22 sec.

388—*Q.—What is the necessary range in differential to accomplish service release?* A.—1 to 1.5 lb.

389—*Q.—How does this compare with the K equipment?* A.—The range for the K equipment is 1 to 5 lb.

390—*Q.—What is the emergency transmission rate for a 150 car W.A.B. rack?* A.—Approximately 950 ft. per sec.

391—*Q.—What is the rate for the K equipment?* A.—Approximately 625 ft. per sec.

392—*Q.—What brake-cylinder pressure is developed in emergency from a 70 lb. charge?* A.—60 lb.

393—*Q.—What brake-cylinder pressure is developed in emergency from a 70-lb charge with the K equipment?* A.—55 to 56 lb.

394—*Q.—What is the limit of service reduction, following which emergency action can be secured?* A.—No limit with the AB brake. With K equipment it is approximately 8 lb. from 70 lb.

395—*Q.—What is the brake-pipe pressure following an emergency?* A.—Zero with the AB brake; with K equipment it is 42 lb. if the brake valve is lapped promptly.

396—*Q.—What is the blow-down time of the quick-action chamber?* A.—70 sec.

397—*Q.—To what pressure does the brake cylinder and the auxiliary reservoir fall during accelerated emergency release following an emergency application from a 70 lb. charge?* A.—It averages about 48 lb.

398—*Q.—Does this always prevail?* A.—No. This figure will vary with different combinations of AB and K equipment.

399—*Q.—What pressure is required in the brake pipe before the accelerated release functions?* A.—About 23 lb.

400—*Q.—Why is this figure established?* A.—In certain mixed combinations of AB and K equipment, the AB vent valves may not reduce the brake-pipe pressure throughout the train below 20 lb. For this reason, and in order to prevent undesired partial release of the AB brakes, this value is used.

401—*Q.—What is the comparative diameters of the service pistons?* A.—In the AB equipment it is 4 in., while in the K equipment it is 3½ in.

402—*Q.—What is the volume of the quick-service bulb?* A.—30 cu. in.

403—*Q.—What is the volume of the quick-action chamber?* A.—160 cu. in.

404—*Q.—How do the feed grooves compare as to capacity?* A.—The orifice capacity is about the same for the AB and the K valves.

405—*Q.—What is the charging time for a completely depleted equipment to 70 lb. when cutting single equipment into a charged train?* A.— 7 min. with the AB equipment and 3 min. with the K equipment.

406—*Q.—How does the recharge time compare?* A.—Practically the same for both types of equipment.

407—*Q.—What is the comparative blow-down time of the auxiliary reservoir?* A.—Approximately 6 sec. with the AB equipment and approximately 3 sec. with the K equipment.

408—*Q.—What units of the AB equipment are interchangeable with the K equipment?* A.—For new equipment, the retaining valve and angle cock are interchangeable; and for conversion, the auxiliary reservoir, brake cylinder (modified) and combination dirt collector and cut-out cock are interchangeable.

409—*Q.—With a fully charged system of 150 cars each 50 ft. long, how many cut-out equipments will a solid train of AB valves jump in emergency?* A.—8 near the center of the train and from 3 to 5 elsewhere.

Copper Tubing for Air Brake Piping

Among the recently introduced products of the Chase Brass & Copper Company, Waterbury, Conn., are seamless copper tubing and accessory fittings for use as air-brake piping. This development is the result of several years of experimental work on hopper cars in the service of the Utah Copper Company. In addition to 300 cars of this company on which copper tubing is now in active service there is one gondola car on an eastern railroad on which copper tubing was installed in 1935.

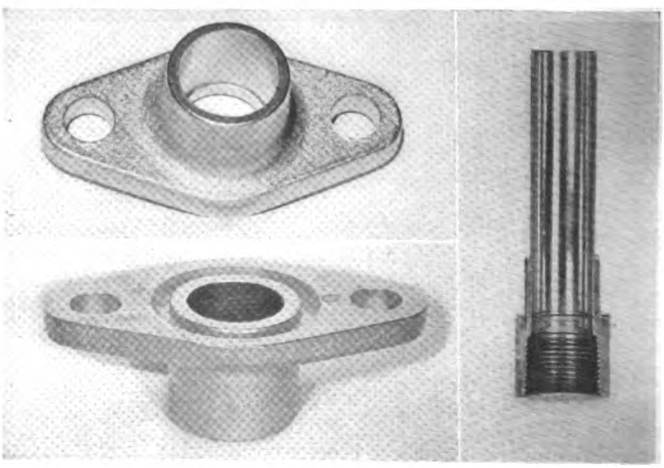
Among the advantages claimed for the use of copper tubing in air-brake service are: (1) Freedom from rust and scale; (2) decreased friction loss; (3) freedom from leakage at soldered joints; (4) saving in weight and (5) practically equal cost of copper tubing and fittings in comparison with iron pipe and fittings.

The copper tubing is made of 99.9 per cent pure copper in seamless form and is supplied in 20-ft. straight lengths, half-hard temper. The accompanying table shows the bursting pressure and breaking load of four sizes of half-hard-temper tubing.

Outside diameter, in.	Wall thickness, in.	Bursting pressure, lb. per sq. in.	Braking load (based on 45,000 lb. tensile strength)
0.500	.035	6,000	2,250
0.875	.045	4,500	5,300
1.125	.050	3,800	7,550
1.407	.065	4,400	12,250

A complete line of wrought copper fittings is available and also a full line of cast bronze fittings consisting of 85 per cent copper, 5 per cent tin, 5 per cent lead and 5 per cent zinc and certain special wrought fittings are made from commercial bronze rod.

The joints between fittings and tubing are soldered



(Left) Two views of a flanged fitting and (right) a cross section of a threaded fitting soldered to copper tubing

with a special solder composed of 95 per cent tin and 5 per cent antimony which has a melting point of 465 deg. F. The process of soldering the joint is quite simple. After tubing and fitting have been thoroughly cleaned and soldering flux applied, the joint is heated evenly by means of a torch. When the proper temperature has been reached the flame is removed and the solder fed into the joint. The surplus solder is brushed off and the joint is finished. Five years of tests have indicated that this type of joint is adequately strong and is resistant to vibration and to creep. It has been used on practically all Diesel-powered streamline trains.

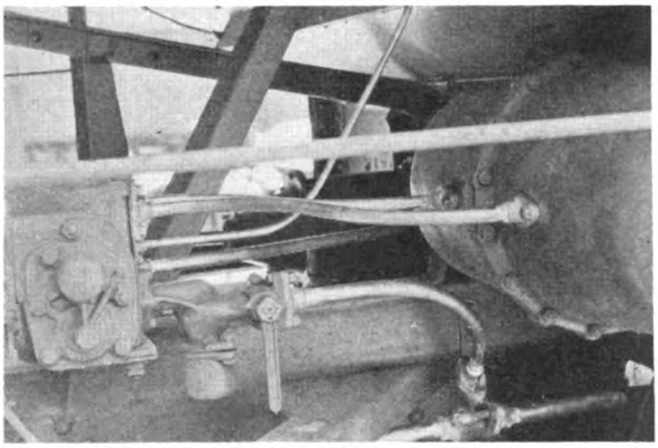
The quantities and sizes of the tubing and fittings used on one of the Utah Copper Company's ore cars, previously mentioned, appear in an accompanying table.

Tubing and Fittings Used on U. C. C. Ore Cars

Location	No. ft. used	O. D., in.	Wall thickness, in.
Main brake pipe	33	1.407	.065
Branch pipe	2	1.125	.050
Emergency and auxiliary reservoir and brake cylinder ...	15	0.875	.045
Retainer pipe	20	0.500	.035

4—1.250-in. SPS* extra heavy nipples, threaded one end with other end bored to fit 1.407-in. tubing
2—1.250-in. standard threaded reinforced-flange fittings
4—1.407-in. sweat flange fittings
2—1.125-in. sweat flange fittings
6—0.875-in. sweat flange fittings
1—0.500-in. sweat flange fittings
1—1.407-in. copper-to-copper coupling
1—0.500-in. copper-to-copper coupling
1—0.500-in. copper-to-copper elbow
1—0.500-in. SPS-to-copper adapter

* SPS—standard pipe size.

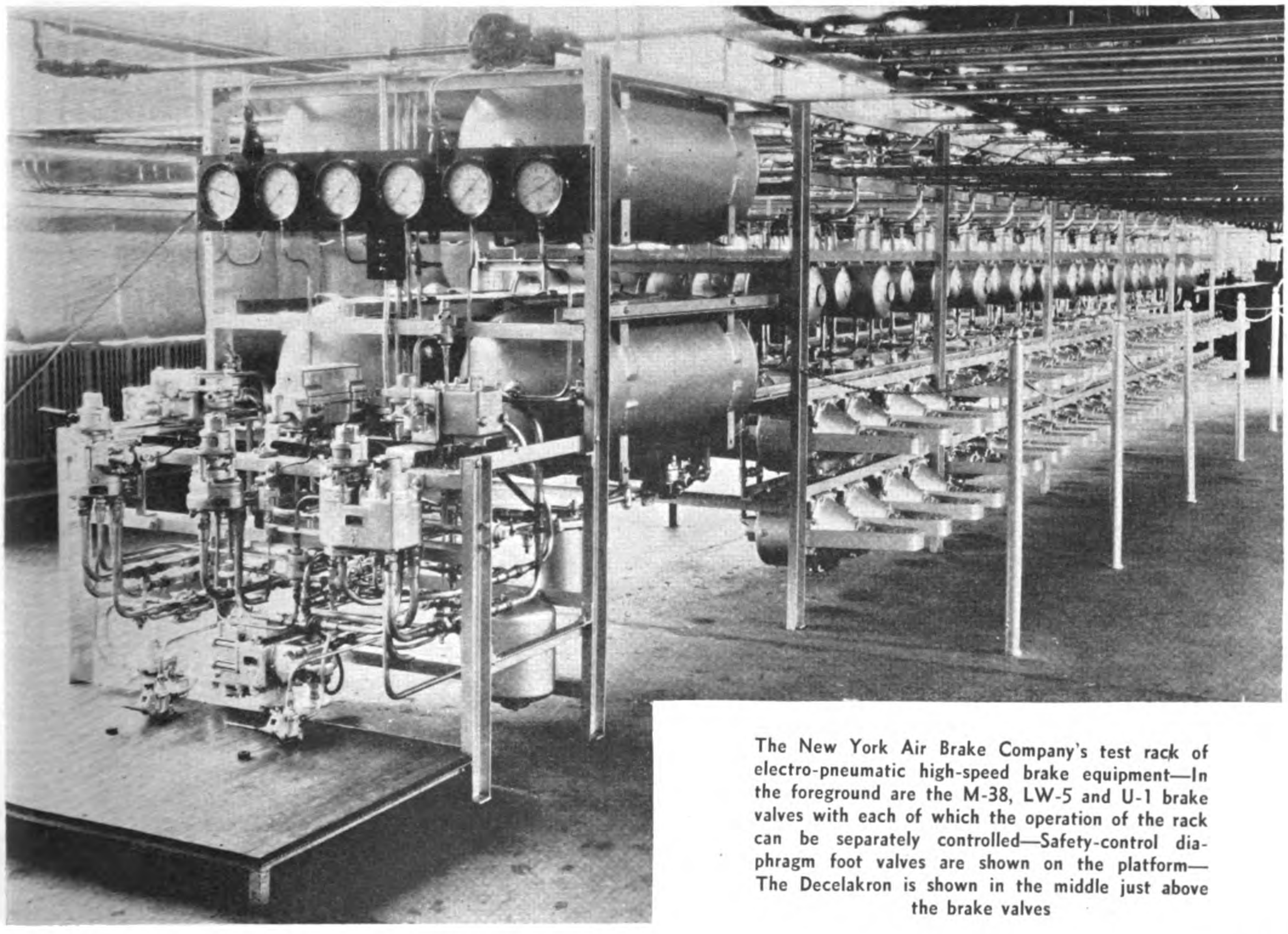


Hopper car air brake piping in which copper tubing and fittings have been used

The weight of the copper tubing used on the Utah Copper Company ore cars is 45 lb. The equivalent quantity of extra-heavy iron or steel pipe would be approximately 136 lb.

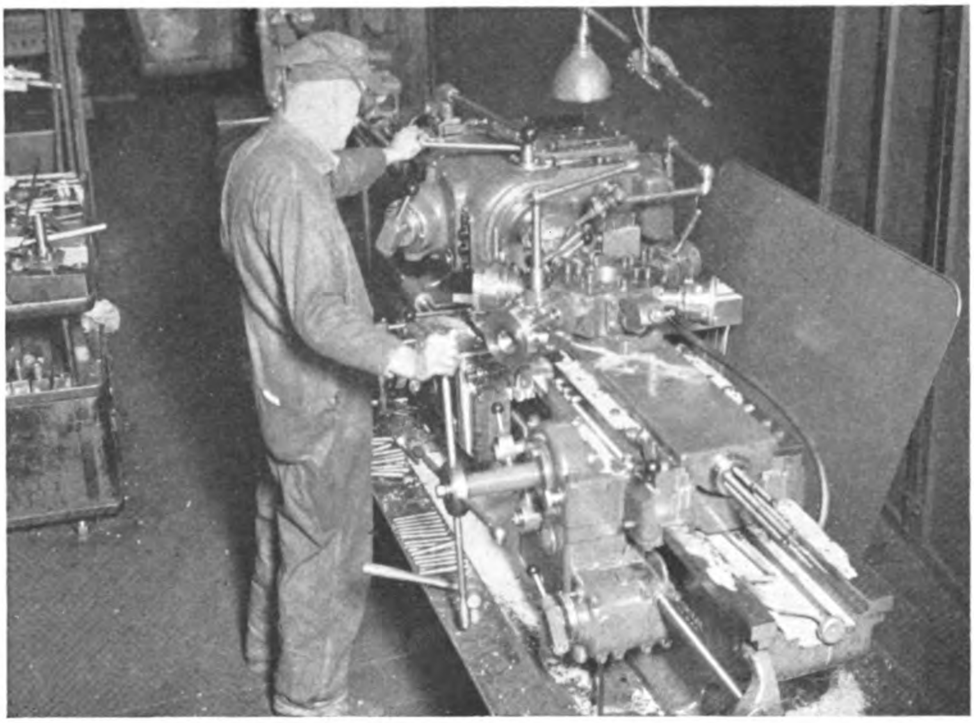
The manufacturer of the tubing and fittings has developed the line of fittings in accordance with the recommendations of the air-brake manufacturers so that the fittings are interchangeable in the event of a breakdown. Repairs to the pipe lines of cars equipped with the copper tube and fittings can thereby be made at any car shop by merely substituting iron or steel pipe and the standard reinforced flanged fitting for the copper tube or the sweat flanged fitting.

* * *



The New York Air Brake Company's test rack of electro-pneumatic high-speed brake equipment—In the foreground are the M-38, LW-5 and U-1 brake valves with each of which the operation of the rack can be separately controlled—Safety-control diaphragm foot valves are shown on the platform—The Decelakron is shown in the middle just above the brake valves

IN THE BACK SHOP AND ENGINEHOUSE



One of the J. & L. turret lathes working on boiler studs

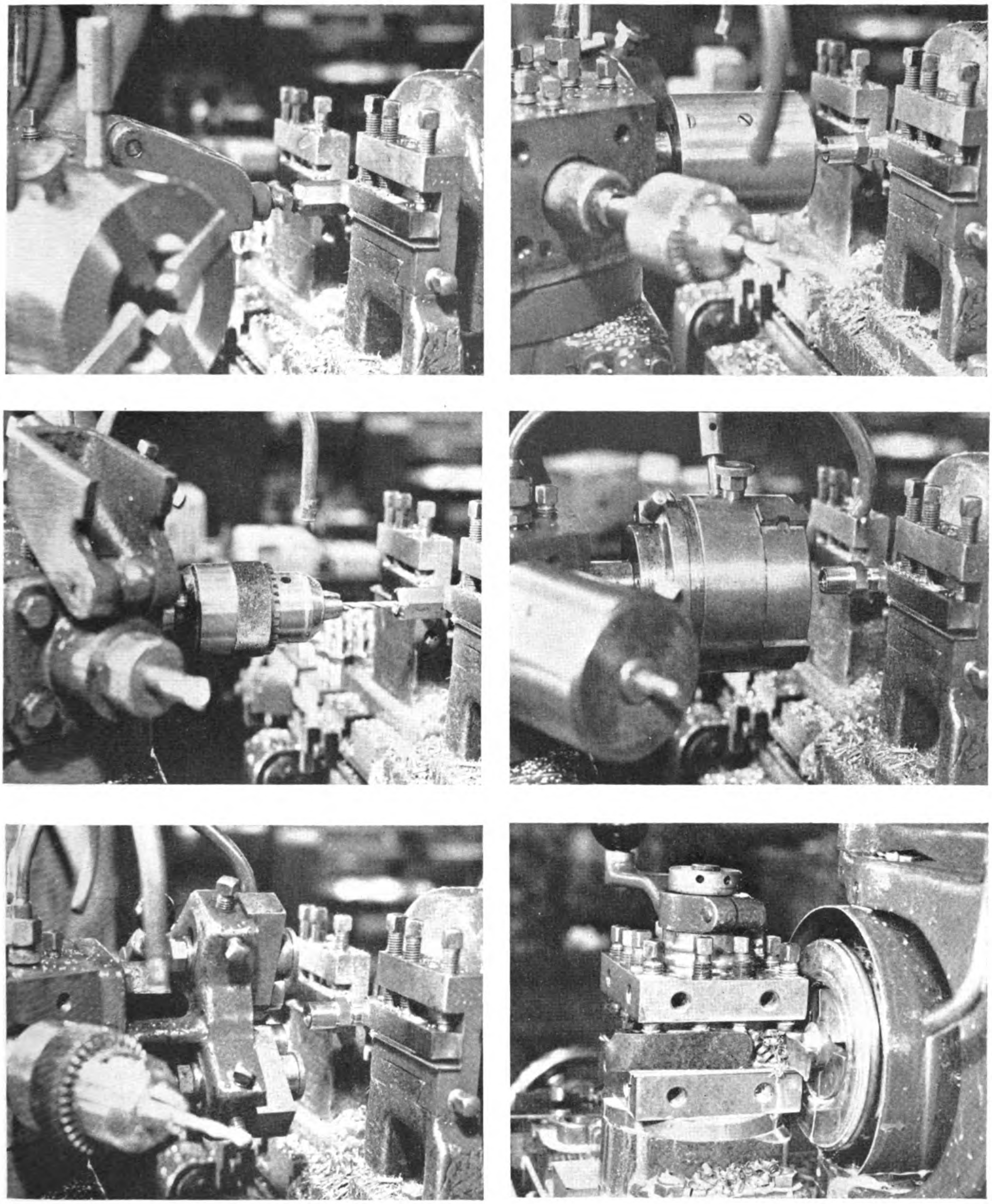
Lehigh Valley Modernizes Turret Lathe Department

Prior to the installation of the present group of modern machines in the turret lathe department at the system shop of the Lehigh Valley at Sayre, Pa., the entire output of such parts as are ordinarily made on this type of machine was produced on a group of 11 turret lathes having an average age of 30 years and varying in age from a minimum of 17 to a maximum of 39 years; 8 of these 11 machines were belt driven, the remaining 3 having direct and independent motor drives.

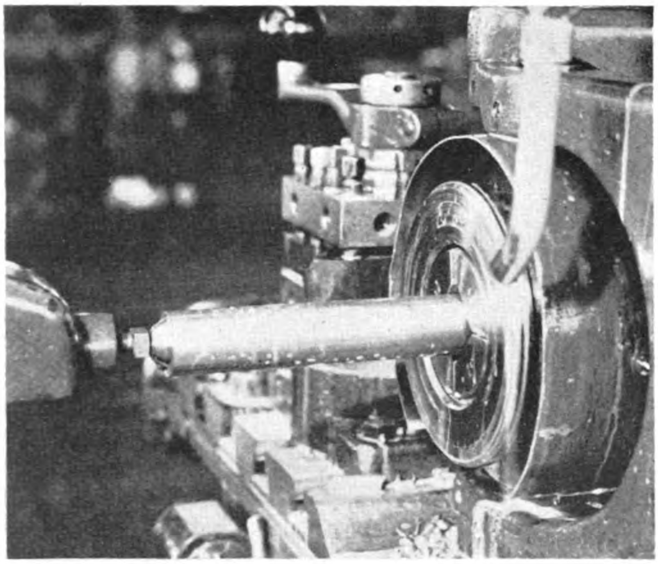
During 1936 it became evident to the shop management that these older machines were not capable of maintaining the desired output at a satisfactory cost. A complete study was made of all of the operations involved in the turret lathe group and, as a result, the 11 old machines were retired and replaced with five new Jones & Lamson turret lathes, the last of which was installed in November, 1937. In spite of the fact that these shops have not been operated at maximum capacity at any time since these new machines were installed, the savings which have been made are such as to justify the cost of installation. The performance of this group of machines so far on quantities of work limited by curtailed production have indicated production increases averaging 150 per cent for the entire group as compared

Table I — New Turret Lathes Installed and Machines Replaced in Sayre Shop

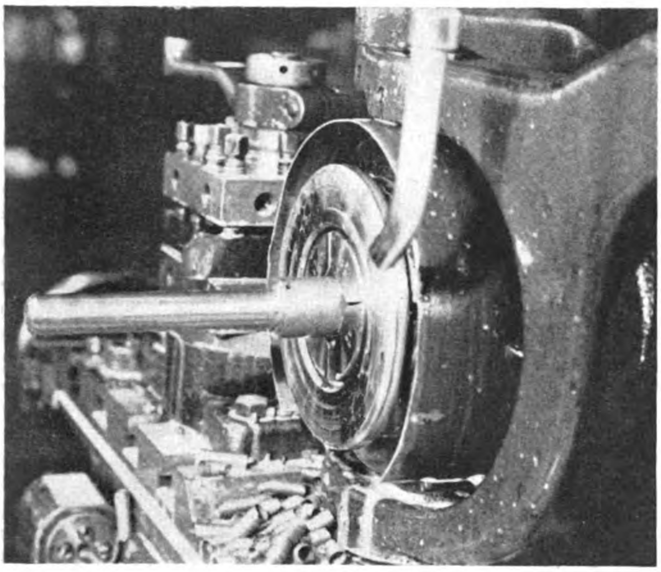
	New Machines			Machines replaced					
Shop No.	Type of Machine	Date installed	Work group	Shop No.	Type of machine	Date installed	Age, yrs.	Type of Drive	Type of work
1454	4-in. Jones & Lamson cross-sliding head flat turret lathe	8-12-37	A	238	5½-in. Gisholt	1903	34	Belt	Pins and bushings
				227	4½-in. Gisholt	1901	36	Belt	Bushings
				237	7-in. Gisholt	1910	27	Motor	Pins and bushings, oversize
				228	6-in. Steinle	1911	26	Motor	Large pins and bushings
1455	1½-in. x 10-in. Jones & Lamson plain ram-type turret lathe. Spindle speeds, 30 to 1,500 r.p.m.	8-12-37	B	226	No. 4 Warner & Swasey	1898	39	Belt	Boiler studs
				235	No. 6 Warner & Swasey	1898	39	Belt	Studs
1456	No. 8D, 3-in. x 36-in. Jones & Lamson universal saddle-type fixed-head turret lathe. Spindle speeds, 20 to 1,000 r.p.m.	10-4-37	C	231	3-in. x 36-in Jones & Lamson	1911	26	Belt	Brake and spring equalizer pins
				234	3-in. x 36-in. Warner & Swasey	1905	32	Belt	Brake and spring equalizer pins
1457	No. 3, 1½-in. x 10-in. Jones & Lamson universal ram-type turret lathe. Spindle speeds 30 to 1,500 r.p.m.	10-18-37	D	233	No. 4 Warner & Swasey	1920	17	Belt	Small valves and pins and small brass work
1464	No. 8A, Jones & Lamson universal turret lathe with bar outfit including thread chasing and taper attachments	11-30-37	E	232	No. 2A Warner & Swasey	1914	23	Motor	Pins and bushings
				236	2½-in. x 24-in. Jones & Lamson	1905	32	Belt	Pins, general use



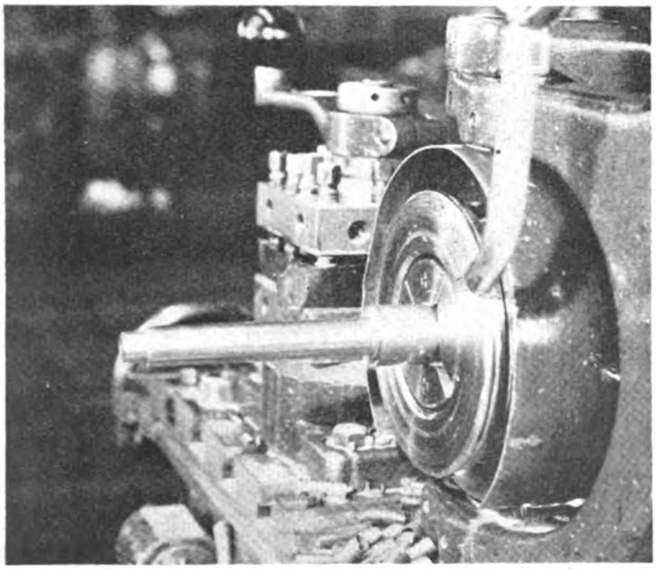
Upper left—the first step in the manufacture of a brass driving box lubricator connection is to bring the stock to length against the stop; center left—here the end of the stock has been countersunk and is now being drilled $\frac{7}{32}$-in. diameter through the piece; lower left—the outside of the large end has been turned with a roller tool; upper right—this is operation No. 6 which consists of tapping the end with $\frac{1}{8}$-in. pipe tap; center right—Operation No. 7 is the cutting of the $\frac{1}{2}$-in. pipe thread on the outside of the large end of the fitting; lower right—the end of the first chucking—the semi-finished piece has been cut off from the bar



Guide brace bolt—Operation No. 1



Operation No. 2—Turning the body



Operation No. 3—Turning the small end

Table II—Work Group A—Machine No. 1454

Bushings made from tubing or round bar:

Diameter, in.		Length, in.	
Outside	Inside	Minimum	Maximum
1⅜	⅞	1¼	2¾
1½	1	¾	3½
1½	1	1	3
1½	1⅛	1	3½
1⅝	1⅛	1	4
1⅝	1¼	¾	3½
1¾	1⅜	1	3½
1⅞	1⅜	1	4
1⅞	1½	1	4
1⅞	1½	¾	2
2	1½	1	4¼
2	1¾	1	4
2⅛	1⅜	1	4
2⅛	1½	1⅝	3½
2⅛	1 9/16	2	4¼
2⅛	1¾	1	4½
2⅛	1⅞	1	4
2¼	1 9/16	1¾	4
2¼	1 11/16	1⅞	4¼
2¼	1¾	1¼	3½
2¼	1⅞	1¼	4½
2¼	2	1½	4½
2⅜	2	1¼	4½
2⅜	2⅛	2	3½
2⅜	2¼	1	4
2½	2	1½	4
2½	2⅛	2	4
2¾	2	1¼	3
2¾	2¼	1¼	4½
2⅞	2	1½	3½
3	2½	1¼	4½
3 1/16	2 9/16	1 13/16	3½
3⅛	2½	1½	4½
3¼	2¾	1⅝	4
3⅜	2½	1¾	4
3½	2½	1¾	4½
3½	3	2	4
3⅝	3¼	1⅞	4½
3¾	3	3	5
3¾	3¼	3	5
3⅞	3⅜	3	4¼
4	3½	2	4½
4¼	3¾	2	4½
4¼	3¾	3	7
4⅜	3¼	2	4½
4⅜	3⅞	3	5

Note: Special sizes are turned on shop order. Approximately 130 of the above sizes may be machined per day from tubing and 40 from round bar stock.

Table III—Work Group B—Machine No. 1455

The following sizes of boiler studs are machined:

Diameter, in.		Length, in.	
Boiler end	Standard end	Minimum	Maximum, average
⅝	⅝	2	10
21/32	⅝	2	10
11/16	⅝	2	10
23/32	⅝	2	10
¾	¾	2	12
13/16	¾	2	12
25/32	¾	2	12
27/32	¾	2	12
⅞	⅞	2½	12
29/32	⅞	2½	12
15/16	⅞	2½	12
31/32	⅞	2½	12
1	1	3	12
1 1/32	1	3	12
1 1/16	1	3	12
1 3/32	1	3	12
1⅛	1⅛	3	12
1 5/32	1⅛	3	12
1 3/16	1⅛	3¼	12
1 7/32	1⅛	3¼	12
1¼	1¼	3¼	12

An average of 350 of any of the above size studs can be machined daily.

with the 11 machines which were replaced. Actual savings have run as high as $700 a month, a decidedly satisfactory return on a total investment in machines, tooling equipment and installation costs totaling somewhat less than $25,000.

With the exception of certain small parts manufactured on two automatic screw machines and a small group of portable lathes located in the erecting shop which specialize on tapered bolts, these five machines take care of all the major requirements of such parts as are indicated for the entire Lehigh Valley system. Table I shows the general specifications and date of installation of the five new machines. Opposite each of the new machines shown in the table are the data relating to the older machines which were replaced by that machine. The general type of work performed on each new machine is also shown in this table and the details of parts and sizes are shown in Tables II to VI, inclusive.

Typical Parts Operations

The illustrations show two typical sets of operations on these new machines. One group of pictures shows the several steps in the finishing of a driving-box force-feed lubricator connection. These brass connections are made in two chuckings, as follows:

Table IV—Work Group C—Machine No. 1456

Pins made from bar iron and steel.

Diameter, in.		Length, in	
Stock	Body	Minimum	Minimum
1½	1	3	5½
1⅝	1 3/32	4	6½
2	1¼	3½	9
2	1 7/32	3¼	5½
2	1⅜	4	7½
2	1 3/32	4	6
2	1 11/32	4	6½
2	31/32	3½	7
2	1 11/16	3½	6½
2	1½	4	9
2¼	1¾	4	10
2¼	1⅞	4½	10½
2¼	1 15/16	4¾	7
2¼	1 11/32	3¼	7½
2¼	1 27/32	7½	9 13/16
2½	2	4	10⅝
2½	1 23/32	4⅜	10
2½	1⅞	4¼	7
2½	1 15/16	4½	7½
2⅝	2⅛	4½	11
2⅝	2¼	4½	11⅞
2¾	2⅛	6	9
2¾	2¼	5½	9
2¾	2	5	9
2¾	2⅜	5	8½
2¾	1 31/32	4¾	6½
3	2	6	10½
3	2¼	4	7
3	2⅜	4½	9
3	2⅛	5½	10½
3	2 5/16	5	9
3	2½	5	8½

Other special size pins and bushings are turned on this machine. Approximately 45 of any of the above sizes may be machined per day.

FIRST CHUCKING

Operation No. 1—Bring stock to stop for length; face and chamfer the end
Operation No. 2—Countersink the end
Operation No. 3—Drill 7/32-in. hole through entire length and turn the back end of the piece while the drilling is being done
Operation No. 4—Turn the front end to size for cutting threads
Operation No. 5—Drill front end to required depth with 13/32-in. drill
Operation No. 6—Tap front end with ⅛-in. pipe tap
Operation No. 7—Thread outside diameter of front end with ½-in. pipe thread
Operation No. 8—Cut off semi-finished piece from bar stock

SECOND CHUCKING

Operation No. 1—Drill the rear end—13/32-in. drill, ⅜ in. deep
Operation No. 2—Thread the rear end ¾ in. 13 threads
Operation No. 3—Countersink the rear end for valve seat with 11/16-in. drill

Table V—Work Group D—Machine No. 1457

Small pins and bolts from ¼ in. to 1¼ in., not over 9 in. long
Studs of all sizes up to 1½ in., not over 9 in. long
Set bolts all sizes up to 1¼ in., not over 9 in. long
Set screws all sizes up to 1¼ in., not over 9 in. long
Hose nipples, ⅞ in. x 3 in.
Lubricator work—pins and bolts, ⅞ in. x 4 in.
Lubricator work taper pins, ½ in., ⅝ in. and ¾ in. x 2½ in.
Brass driving box connection, ¾ in. x 2 in.
Brass guide fittings, ¾ in. x 2½ in.
Brass nipples not to exceed 1½ in.
Copper collars—button-head up to 1½ in. diameter
Any other copper work up to 1½ in. diameter
Approximately 70 of any of the above sizes may be machined per day.

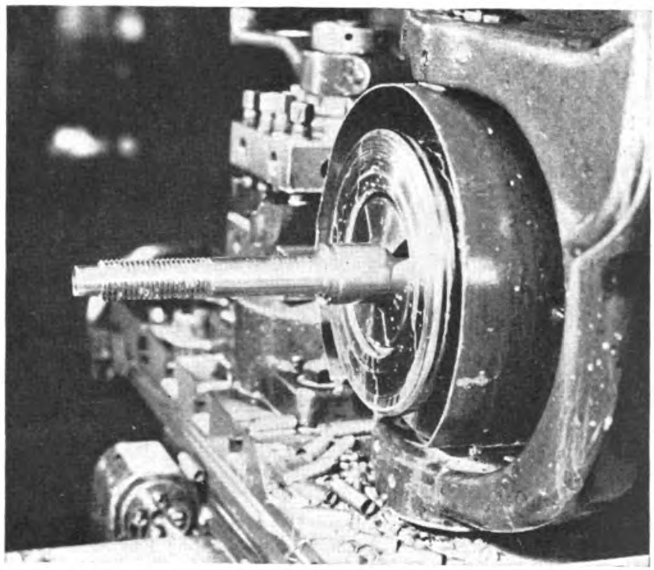
The operation time for the first chucking is 65 seconds and for the second chucking 18 seconds, making a total time for each piece of 1 min. 23 seconds.

The other group of illustrations shows the several steps in the machining of a guide brace bolt which is made from open-hearth bar stock 1⅜ in. in diameter. The details of the operations and the time follow:

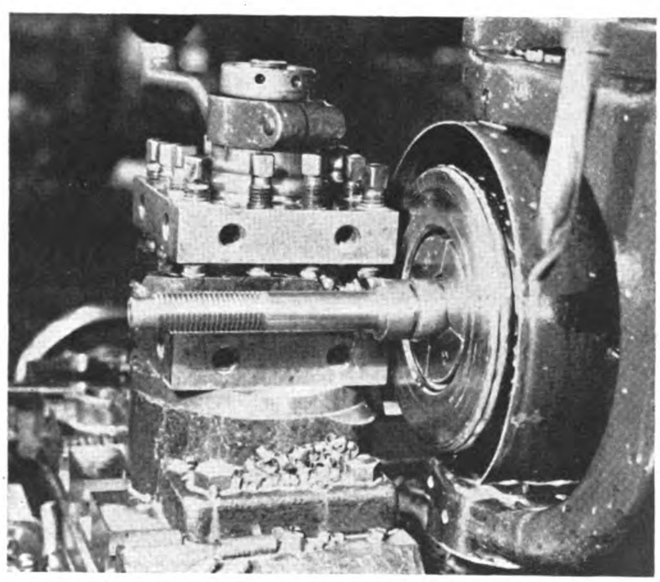
Operation No. 1—Bring stock to length, face end and chamfer. Speed, 340 r.p.m., time, 25 sec.
Operation No. 2—Turn the body of the bolt. Speed, 243 r.p.m., time, 80 sec.
Operation No. 3—Turn the small end of the bolt. Speed, 243 r.p.m., time, 20 sec.
Operation No. 4—Cut the threads on the bolt. Speed, 42 r.p.m., time, 32 sec.
Operation No. 5—Cut off. Speed, 340 r.p.m., time, 50 sec.
Total time—3 min. 27 sec.

Table VI—Work Group E—Machine No. 1464

Stay-plate bolts, 1⅜ in. x 5½ in. from 1¾ in. hex steel
Spring-rigging bolts, 1¾ in. x 7 in. x 9 in.—10 in. from 2½ in. rolled steel
Brake-rigging bolts, 1¼ in. up to 1¾ in. from 4 in. to 10 in. long
Tapered plugs for driving boxes, ⅞ in. x 2 in., 1 in. x 2 in.
Patch bolts, from 1 1/16 in. to 1 15/16 in. x 3 in. long
Boiler plugs, 1 in. to 2 in. x 1½ in. long
Grease plugs for driving rods, 1⅞ in. x 3 in. long
Grease plugs for driving rods, 2½ in. x 3 in. long
Motion-work pins, 2 in. x 6 in.
Bolts for electrical department, 2 in. x 16 in.
Pins and nipples, etc., up to 3 in. diameter
Approximately 40 of any of the above sizes may be machined per day.



Guide brace bolt, Operation No. 4—the threads have been cut on the body of the bolt



Operation No. 5—Ready to cut off from the bar

Locomotive Driving Journals Are Oil Lubricated

Designed to minimize locomotive failures due to hot driving boxes, a system of oil lubrication for driving journals and hubs has been developed by the motive power department of the Southern Pacific and installed on two 4-8-2 type locomotives, one of which, No. 4340, is shown in the illustration. Two other locomotives are now being equipped.

The new system substitutes oil for the conventional grease in driving boxes, eliminates hand lubrication of driving wheel hubs and minimizes the scoring of journals. Journal temperatures under operating conditions are reduced by more than 100 degrees.

The system, in part, comprises the use of spring-supported lubricating pads, heretofore used only in modern passenger car, engine and trailer trucks. The use of these spring lubricator pads on driving boxes entails only a minor change in the conventional grease cellars to provide for a cellar from which oil is drawn up by wicking into a pad in constant wiping contact with the journal.

Supplementing the spring pads in the new driving box lubricating system, as a further guarantee against lubrication failure, oil from the locomotive's mechanical lubricator is constantly fed through tubes into the crown bearings.

To improve the lubrication and wearing properties of the brass crown bearings, a serrated recess in each brass is filled with white metal as a bearing surface. This white metal has the characteristic of maintaining an even distribution of oil over its surface, and it is soft enough so that the scoring of journals is substantially minimized should the bearings become overheated for any reason.

Tests of locomotives equipped with the improved oil-lubricating system are said to show remarkably low journal temperatures under all operating conditions. Pyrocon readings on the surface of the journals have indicated temperatures, as low as 70 deg. F. and only as high as 130 deg. F. Under the same conditions conventional brass crown bearings, grease lubricated, are said to average between 200 and 350 deg. F.

The system also provides positive automatic lubrica-

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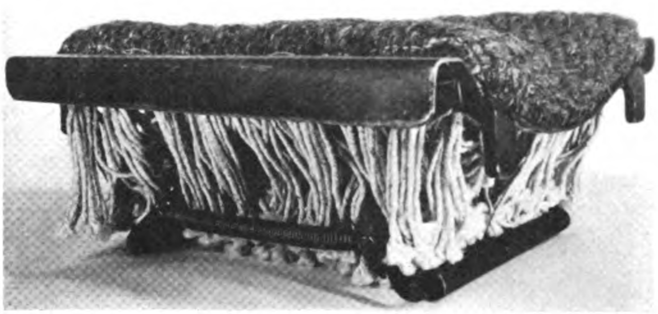
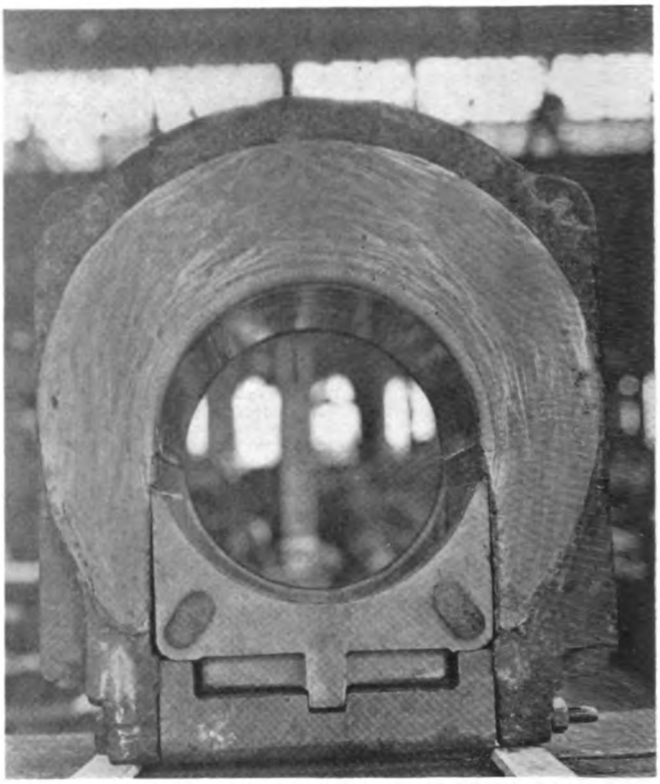
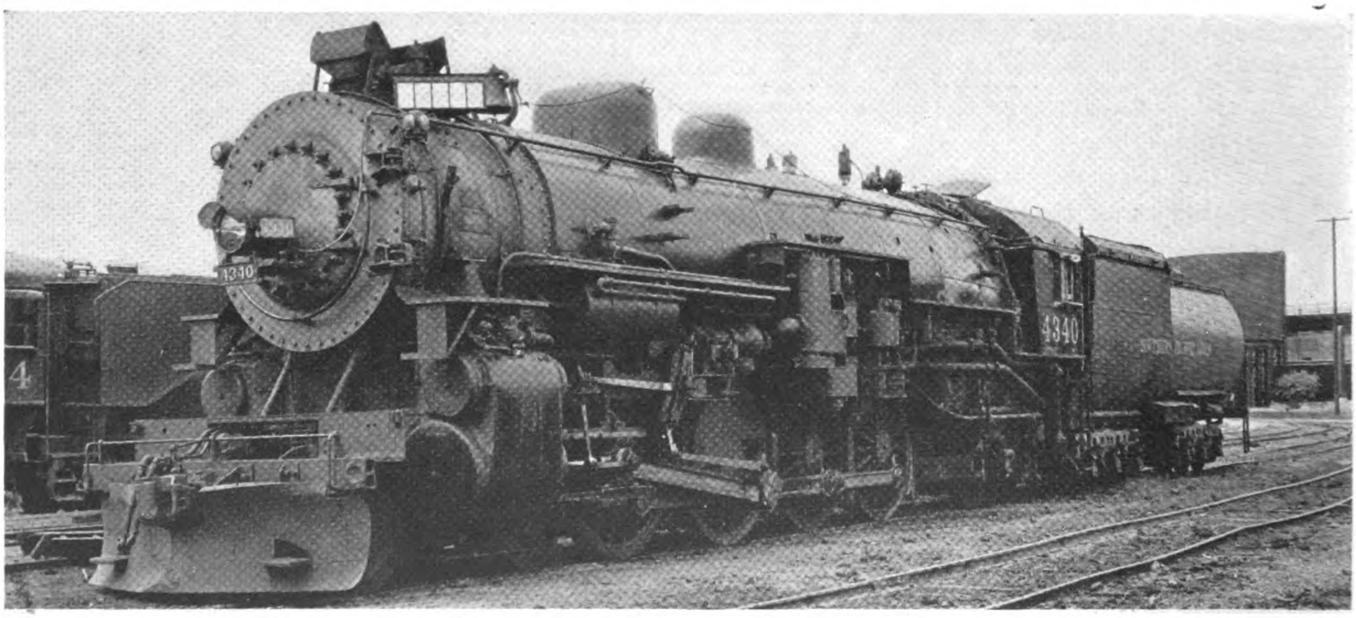


Driving box spring pad lubricator—The wicking draws up oil from the cellar to saturate the pad, which is held by spring tension in constant contact with the journal



Felt pads on the oil cellar lubricate the hub—Coil spring mountings on the latches permit free lateral motion on driving-box spacers when the wheel hubs come in contact with the pads



Locomotive 4340, one of two Southern Pacific locomotives now equipped with oil lubrication throughout

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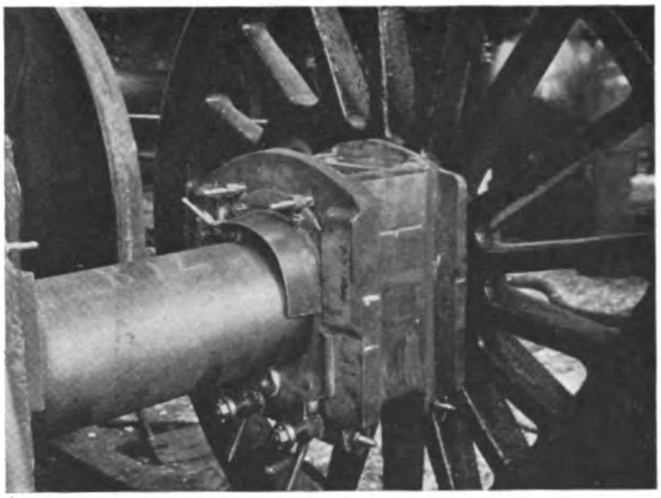

Driving box oil-cellar assembly with water guard in place

tion of driver hubs by means of two hard felt pads inserted in slots at the rear of the oil cellar. These pads project ⅛ in. beyond the babbitted face of the box and at the inner ends are fed from the cellar through small holes.

Cellars are held in place by latches fitted with coil springs to permit free endwise movement of the cellars when the wheel hubs come in contact with the felt pads due to lateral motion. The cellars are easily withdrawn without removing cellar bolts as was formerly necessary.

Heretofore it required one man about 80 minutes to repack the conventional grease cellars in eight driving boxes of a mountain-type locomotive, whereas filling the eight oil cellars may be accomplished in ten minutes with consequent reduction in the cost of lubrication, both labor and material. A glass bull's eye sight on the cellar shows the exact oil level.

The two Southern Pacific locomotives on which the new system has been installed are now 100 per cent oil lubricated. Trailer- and tender-truck journals are lubricated by spring pad lubricators, and driving boxes and engine journals are lubricated by spring pad lubricators and the mechanical lubricator. The mechanical lubricator also provides lubrication for shoes and wedges.

The cost of lubricant for all journals, hubs, shoes and wedges on each of these locomotives is said to be only about $1.75 per 1,000 locomotive miles.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Efficiency of Patches at Boiler-Check Holes

Q.—In applying a reinforcement patch at the boiler check, should the patch applied be the same thickness as the shell course or may thinner material be used?—C. S. B.

A.—The efficiency of any boiler patch applied to the shell of a boiler should be at least equal to the efficiency of the longitudinal seam of the boiler shell course to which it is applied.

It is not necessary that the thickness of the patch be the same as the thickness of the boiler shell course to which it is applied, provided the efficiency of the patch is at least equal to the efficiency of the longitudinal seam. However, it is good practice to make the patch the same thickness as the shell course, because the efficiency of a well-designed diamond-shaped patch is usually obtained along the outside diagonal row of rivets. This efficiency would also be the efficiency of the shell course along this row of rivets, and for this reason the allowable working pressure on the patch, based on the efficiency along the diagonal row of rivets, would also apply to the shell course provided the thickness of the patch and the shell course were the same.

Where is the Breaking Zone of a Firebox?

Q.—Where is the breaking zone of a firebox, or where would you consider the bolts most likely to break?—S. A. W.

A.—The staybolt breaking zone in a firebox is generally accepted as being as follows: (1) In the throat at the two outermost rows on the sides, although some road include all the throat stays. (2) In the back head at the two outermost rows on the sides and around the top of the door sheet. (3) In the side sheets at (*a*) the two front vertical rows up to the expansion stays, (*b*) the two back vertical rows up to the radial staybolts, (*c*) the two top longitudinal rows of water-space staybolts, and (*d*) the staybolts in the upper front and rear inner corners formed by the staybolts covered in items *a*, *b*, and *c*.

Increases in Boiler Capacity Effected by Feedwater Heater

Q.—How is the increase in boiler capacity due to the use of a feedwater heater determined?—R. J. F.

A.—The boiler capacity is increased by the use of a feedwater heater due to the increase in the temperature of the water being delivered into the boiler, thus requiring less heat to change the water to steam.

The following calculations show the increase in evaporation due to the use of a feedwater heater and are based on test data obtained during maximum operation of the boiler. Given: boiler pressure = 200 lb. per sq. in.; temperature of feedwater = 60 deg. F.; temperature of feedwater delivered by feedwater heater = 230 deg. F.; evaporation of boiler without feedwater heater = 39,600 lb. per hr.

Referring to standard steam tables we find that the heat in one pound of steam at 200 lb. per sq. in. gage = 1,199 B. t. u., and the heat in one pound of feedwater at 60 deg. F. = 28 B. t. u.; therefore, the heat required to raise one pound of water at 60 deg. F. to one pound of steam at 200 lb. per sq. in. gage = 1,199 — 28 = 1,171 B. t. u. The heat in one pound of feedwater at 230 deg. F. = 198 B. t. u.; therefore, the heat required to raise one pound of water at 230 deg. F. to one pound of steam at 200 lb. per sq. in. gage = 1,199 — 198 = 1,001 B. t. u.

The heat required to evaporate 39,600 lb. of water per hr. from 60 deg. F. to steam at 200 lb. per sq. in. gage = 39,600 × 1,171 = 46,371,600 B. t. u. The water that could be evaporated to steam at 200 lb. per sq. in. gage by this amount of heat, if the feedwater was

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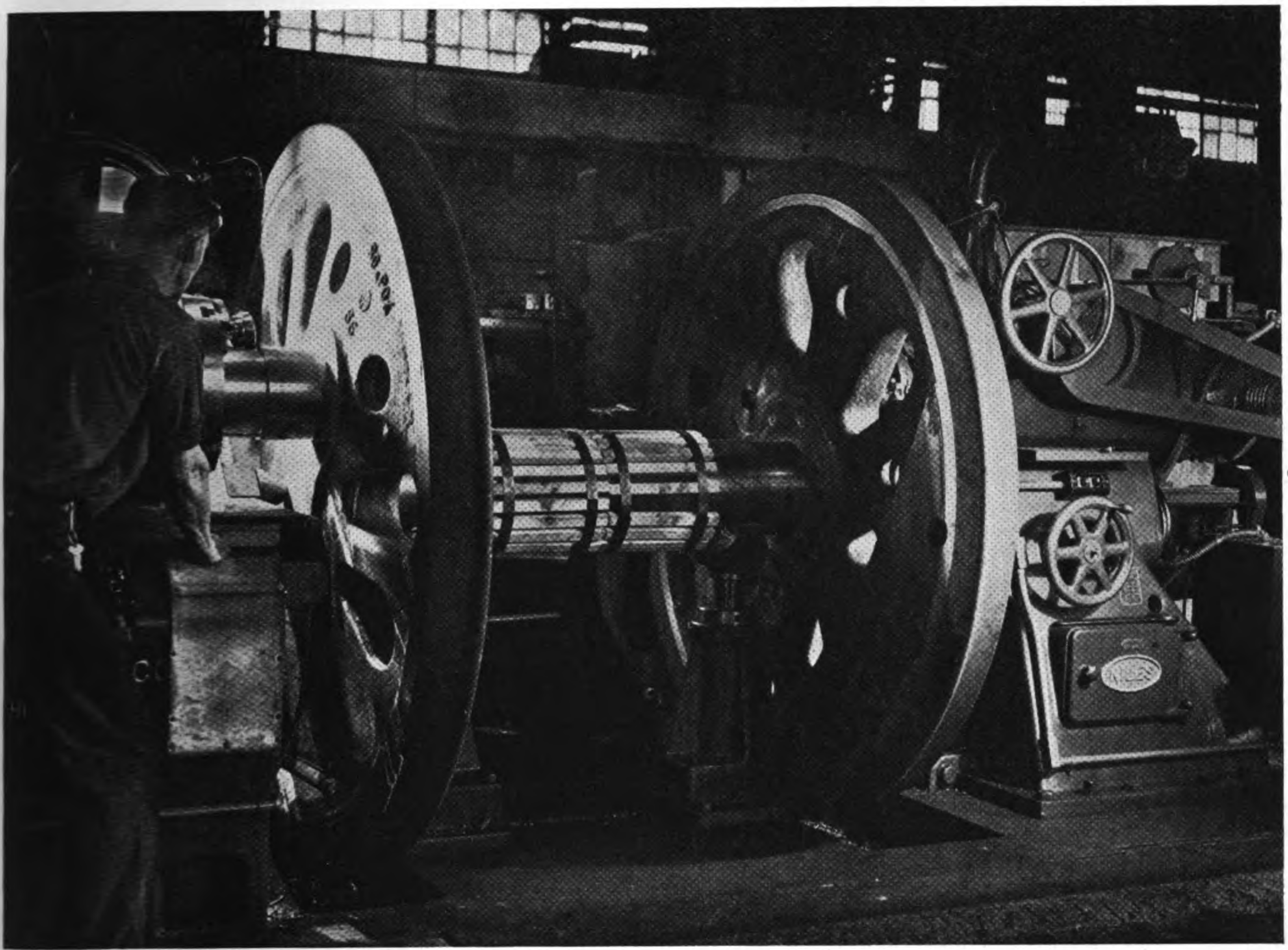
METHODS AND MACHINERY THAT GUARD LIMA QUALITY



Crank Pins Get a Mirror Finish

In a modern quartering machine the crank pins at Lima are given a final mirror finish by a rolling operation » » » The surface of the pin is accurately prepared for the rod and this extra care contributes its part in the reputation Lima has earned for building sound, low-maintenance power.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

at 230 deg. F., would be 46,371,600 / 1,001 = 46,325 lb.

Assuming that the feedwater pump requires two per cent of the steam consumption we have 46,325 × 0.02 = 926 lb. of steam per hr. to operate the pump. Thus, 46,325 — 926 = 45,400 lb. of steam per hr. net evaporation with the feedwater heater, or 45,400 — 39,600 = 5,800 lb. per hr. additional evaporation due to use of the feedwater heater.

Why Welded Plates Buckle

Q.—In butt welding 1/16-in. to 3/16-in. plates in tank and cab work, considerable difficulty has been experienced with plates buckling. What causes this condition and how can this condition be overcome?—F. L. M.

A.—The buckling or warping is due largely to the fact that steel expands when heated and contracts when cooled. The amount of contraction or expansion depends upon the temperature change and the areas involved.

When butt welding, certain physical changes take place. As the molten metal from the welding wire is deposited at the seam, the plate adjacent is heated and tries to expand but is more or less restrained by the colder metal farther away from the seam. The plate near the weld will be heated sufficiently so that it will be forced to undergo plastic deformation, and upon cooling will attempt to assume a shape different than before welding.

The plate adjacent to the weld first expands and then contracts. Therefore, it can be said that as the welding proceeds there is a zone around the arc in which the metal is in the process of cooling and contracting. The weld metal is a part of this latter contracting zone. The net result is that the plates are stressed to a certain degree causing buckling or warping.

To overcome this difficulty the welding procedure must be such that there are no excessive localized stresses during the welding; this is generally accomplished by using what is termed "Skip welding." This method consists in keeping the expanding zones sufficiently narrow and sufficiently close to the contracting zones so that they tend to stress relieve or neutralize each other. This can be accomplished by making a short weld, then skipping some distance ahead, making another short weld, etc., and then returning to the first weld and making another weld adjacent to it, etc. Sufficient time should elapse between making adjacent welds so that the first weld is sufficiently cool and is completely contracted.

Clamping the work is another simple method of reducing warping. This is more effective when the welded members are allowed to cool in the clamps.

Welded Front Tube Sheets

Q.—Would it be permissible to weld the front tube sheet to the shell of a locomotive boiler?—J. S.

A.—The question does not state the type of construction used. If it were the intent to take a typical flanged-type front tube sheet and weld it to the shell around the edges omitting the rivets, it would not be permissible as the strength of the structure would be dependent upon the strength of the weld.

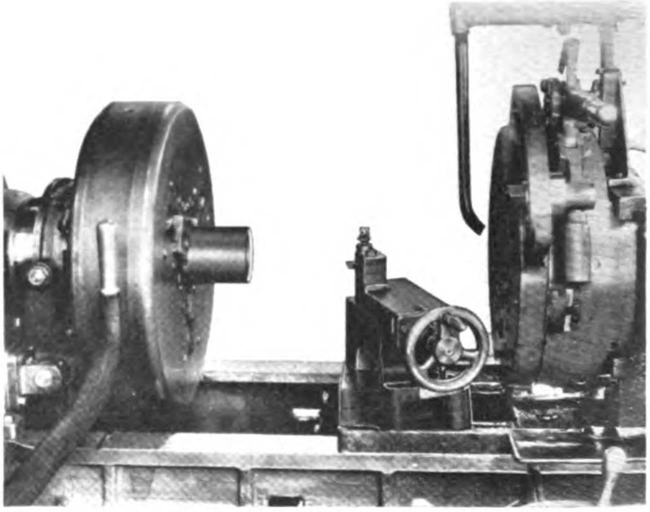
Front tube sheets are being welded on some roads in the following manner: A ring-shaped band is riveted to the inside of the shell and a flat tube sheet is set in behind it; the tube sheet is then welded to the band on the smokebox side, thus eliminating any welding to the shell itself. The weld does not have to hold the pressure, the band taking the load, but simply serves as a seal; thus, the strength of the structure is not dependent on the strength of the weld.

At least one all-welded boiler has been constructed. In this boiler the front tube sheets were held by welded construction. The boiler, however, was constructed as an experiment and special permission was obtained from the Bureau of Locomotive Inspection for its construction.

Tool for Beveling Pipe

The Landis Machine Company, Waynesboro, Pa., recently modified the construction of its line of pipe-threading and cutting-off machines by including a beveling unit on the carriage immediately in front of the threading head. This change was made in order to insure a more accurately formed beveled surface suitable for high-pressure pipe installations using flange joints having gaskets which seat against the beveled ends of the pipe. Although used on all new machines, this beveling tool can be applied to the older models of Landis pipe threading and cutting machines.

In prior constructions the beveling unit was placed back of the threading head, and the pipe overhung a considerable distance beyond the chuck jaws while the beveling operation was being performed. This overhang can



Landis pipe-threading and cutting-off machine equipped with a beveling unit

be materially reduced by the use of a pipe support; however, since the pipe may be somewhat out-of-round, the finished bevel is often unsuitable for application when it is utilized as a sealing surface. With the present arrangement, the pipe end overhangs the chuck jaws a relatively short distance, and its rigidity makes it possible to produce a smoothly finished bevel; where a thread is used in connection with the beveled surface, the bevel is formed absolutely concentric with the thread.

The beveling assembly is pivoted on a base which has been cast integral with the forward projection of the die-head carriage. This base has a graduated scale to show the inclination of the tool assembly with respect to the center line of the pipe. The tool-holder slide has a dove-tailed slot to engage the corresponding dovetail of the base member. A gib is provided so that the clearance between the dovetail and its slot can always be maintained at any desired value. Thrust collars are used on the feed-screw shaft to minimize wear between the shaft and the tool-holder slide.

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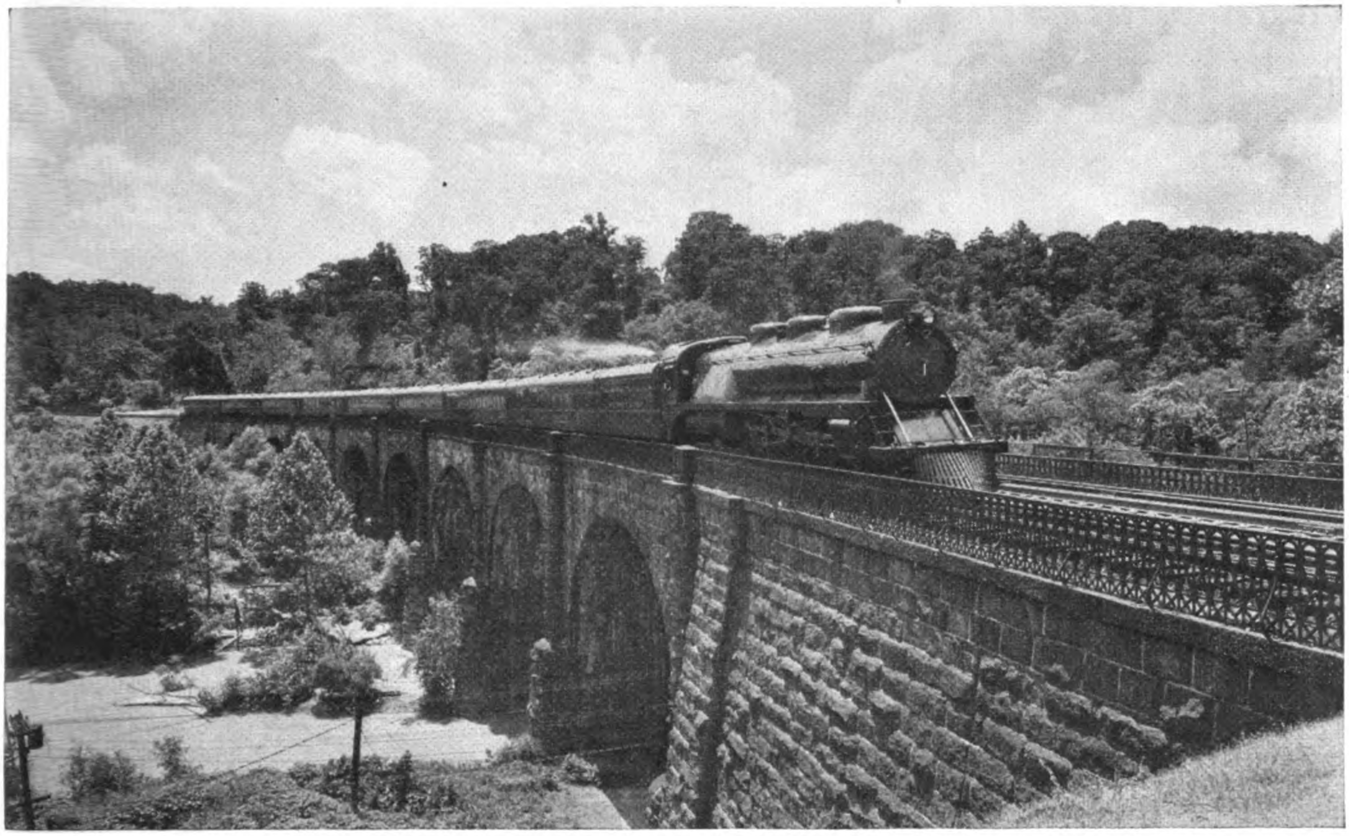
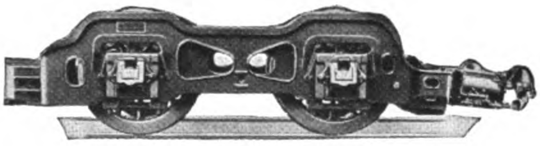


WHEEL LOAD LIMITS

need not cramp your operations

Limited axle loads can still produce an efficient modern locomotive if idle trailing wheels are put to work for starting and acceleration. » » » Incorporate The Locomotive Booster* in the fundamental design and thereby raise the starting power and improve acceleration without impairing the factor of safety on existing tracks.



* Trademark Registered United States Patent Office

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FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

High Spots in
Railway Affairs . . .

Lea on the Job In the House

If Chairman Lea of the House Committee on Interstate and Foreign Commerce has his way, something will surely be done by the present Congress to help the railroads out of their difficulties. Hearings continue to be held on the so-called Lea omnibus transportation bill. Many interests are anxious to present their points of view on various phases of the problem, but the chairman on February 16 asked witnesses to make their statements more brief, else it will not be possible to enact legislation at the present session. Congress is apparently looking forward to earlier adjournment than usual. Fortunately the railroad problem appears to be slated as one of the few "must" items at this session of Congress, the Administration recognizing the importance of railroad prosperity as a vital factor in national recovery. Under these circumstances we may really get somewhere.

Amlie's Nomination May Be Withdrawn

One news commentator—we don't recall his name—suggested that the President was not overfond of the Interstate Commerce Commission and so took occasion, when new appointments were to be made, to select men whose presence on the Commission might prove embarrassing to the other members. If that is true, then the President surely made a good guess in nominating Thomas R. Amlie to succeed Balthasar H. Meyer. It is doubtful if any nominee for appointment to the Commission has ever been so widely and scathingly discussed in the press. A subcommittee of the Senate Committee on Interstate Commerce has held hearings on Amlie's nomination, and there is a rumor as this is written that an effort will be made to induce the President to withdraw the nomination. In any event, it is extremely doubtful if the Senate will confirm the nomination of a man who has been subject to such general and harsh criticism. Mr. Amlie, a former congressman, was defeated last year for senatorial nomination on the Progressive Party ticket of Wisconsin. In a hearing he denied being a Communist and said he held the same views on government ownership of railways as does Commissioner Eastman.

Wheeler Fiddles On

Congress and the Administration are faced with a grave responsibility to the public for the successful operation of the railroads which form the backbone of the American transportation system. Efficient and low-cost transportation is fundamental to the development and prosperity of the nation. Real statesmanship is required and prompt action is necessary—indeed, the task should have been squarely faced up to and completed years ago. Undoubtedly there have been, and quite probably still are, some shortcomings and abuses in the financial operation of the railways. That, however, is true to a like extent in other industries and businesses and in the government itself. Go ahead, Senator, and continue to study and correct these abuses wherever possible, but there will not be much left to deal with, unless constructive and positive action is quickly taken to free the railroads from some of the unfair hardships under which they are now forced to operate. It is high time that the Senate Interstate Commerce Committee did something besides grind out a series of reports of one of its subcommittees, which has been making a study of railroad holding companies, and yet that is about all that it did in the second month of the present Congress, except for the bill introduced by Senator Wheeler to amend the Interstate Commerce Act, by giving the Commission broad powers to regulate the spending of railroad funds for the purchase of other railroad companies.

Commissioner McManamy May Be Replaced

Much to the surprise of railroaders, the President finally decided not to let Commissioner Frank McManamy carry on as a member of the Interstate Commerce Commission until his seventieth birthday, September 3, 1940, and so sent to the Senate the nomination of J. Haden Alldredge to succeed him. Apparently railroad labor leaders were led to believe that Commissioner McManamy would not be disturbed until he reached the age of seventy and also that they would be consulted as to his successor. Mr. McManamy is said to have commented thus: "If we are going to encourage career men, why throw them out when they approach the retirement age? If we are going to have promotions through the civil service, why throw people out when they reach the top?" Mr. Alldredge, a commerce attorney and transportation specialist, is an Alabamian. He has had service in industrial traffic work; was secretary and traffic manager of the Chamber of Commerce, Dothan, Ala.; was admitted to the bar and has practiced before the Interstate Commerce Commission; was chief of the Transportation Bureau of the Alabama Public Service Commission, and more recently was a director of T. V. A.'s commerce department. This department, as characterized by a T. V. A. press release, is "one of the departments created during the recent reorganization of the Authority—another step in the development of a navigation channel in the Tennessee river for commercial use." Railroad labor does not take kindly to Commissioner McManamy's removal and it may be difficult to secure Senate confirmation of Mr. Alldredge's nomination.

Juniors Raise a Howl

Junior, or furloughed train and engine service employees to the number of eighteen, appeared at a hearing held by the House Committee on Interstate and Foreign Commerce on February 16. Their spokesman was Ernest A. Ledwith of Emporia, Kan., a Santa Fe engineer and a member of the Brotherhood of Locomotive Firemen and Enginemen. He pointed out that the federal wages and hours law calls for a maximum week of 44 hours. Many of the "old heads" in train and engine service, however, work from "38 to 60 days per month." If a 26-day maximum month was made effective in railroad service it would put back to work one third of the employees who are now furloughed, said Mr. Ledwith. "Transportation employees of the United States have been graciously and liberally rewarded by dear old Uncle Sam," he said, "and yet their gratitude is shown by the most selfish and hard-hearted methods, the exercise of unbridled seniority. Their attitude is very blunt—they decree the junior man has no right to honest labor until their gluttonous desires, that have taken on the form of insanity, are appeased."

Railway Express Agency Observes Centenary

Early in 1839 William F. Harnden, a ticket agent and conductor of the Boston & Worcester, devised a plan for carrying small parcels, money and valuable papers from place to place on a for-hire basis. It is a far jump from one man with a carpetbag suitcase in 1839 to the Railway Express Agency of today, with its 70,000 employees, doing a business throughout our own country and in many foreign lands. On March 1, 1929, the Railway Express Agency became the property of the railways. Its capital stock is owned by 70 roads, over the lines of which more than 98 per cent of the express business is handled. In 1937 it carried 140,000,000 revenue shipments, many of which consisted of two or more pieces. This required the maintenance of 23,000 offices. More than 11,000 motor vehicles are required for local pick-up and delivery, inter-city transfer between railway stations and over-the-road hauls of shipments in certain cases.

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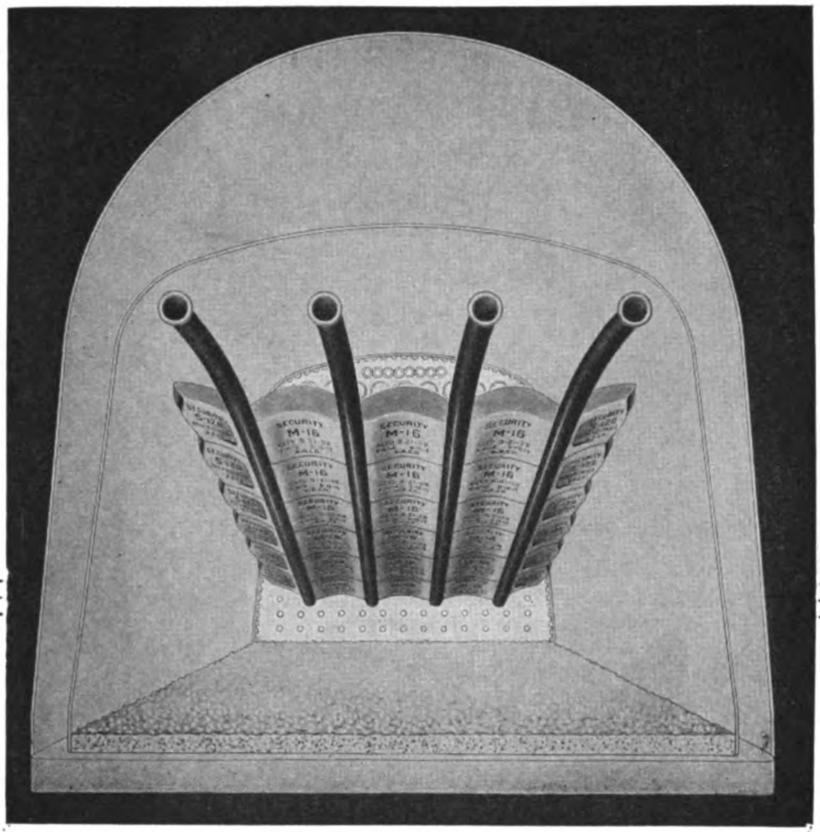

ANYTHING

less than a complete arch

IS FALSE ECONOMY

To let the desire for reduced inventory result in a locomotive leaving any roundhouse without a full set of Arch Brick is poor economy. » » » Even a single missing Arch Brick will soon waste many times its cost in fuel and in locomotive efficiency. » » » To spend the fuel dollar efficiently, every locomotive Arch must be maintained 100%. » » » Be sure your stocks on hand are ample to provide fully for all locomotive requirements, so that locomotive efficiency may be maintained.

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HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

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Locomotive Combustion Specialists

Among the Clubs and Associations

NORTHWEST CAR MEN'S ASSOCIATION.—"Lubrication" was the subject discussed by L. T. Evans, manager of the Hoosier Waste Renovating Company, at the March 6 meeting.

TORONTO RAILWAY CLUB.—Ladies Night, concert and dancing, also bridge and buffet supper, will feature the meeting to be held at 8:30 p. m. on March 27 at the Royal York Hotel, Toronto, Ont.

CAR MEN'S ASSOCIATION OF CHICAGO.—The Griffin Wheel Company's sound picture and slides on the chilled-iron car wheel will be presented at the meeting to be held at 8 p. m. on March 13 at the La Salle Hotel, Chicago.

CANADIAN RAILWAY CLUB.—"Steam Locomotive Slipping Tests" will be discussed by T. V. Buckwalter, vice-president, Timken Roller Bearing Co., at the meeting to be held on March 20 at 8:15 p. m. at the Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—A paper on The Car Inspector will be presented at the meeting to be held at 8 p. m., on March 21 at the Hotel Mayfair, St. Louis, Mo. Dinner will precede the meeting at 6:15 p. m.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—F. H. Hardin, president, Association of Manufacturers of Chilled Car Wheels, discussed wheel defects and presented the sound motion picture, "How Wheels Are Made," at the March 6 meeting.

MECHANICAL DIVISION, A. A. R.—The annual meeting of the Mechanical Division of the Association of American Railroads will be held in New York, June 28, 29 and 30. Sessions will be held in the East Ball Room of the Commodore Hotel, convention headquarters.

NEW ENGLAND RAILROAD CLUB.—The fifty-sixth annual meeting will be held at 6:30 p. m. on March 14 at the Hotel Touraine, Boston, Mass. Officers for the coming year will be elected, and a motion picture of the United States Steel Corporation "Steel—Man's Servant," will be presented.

CENTRAL RAILWAY CLUB OF BUFFALO.—The Chilled Car Wheel was discussed by John Matthes, chief car inspector, Wabash; W. R. McMunn, superintendent rolling stock, Merchants Despatch Transportation Corporation, and A. J. Krueger, superintendent car department, New York, Chicago & St. Louis, at the March 9 meeting. The sound motion picture, "The Story of the Chilled Car Wheel," was also presented.

EASTERN CAR FOREMAN'S ASSOCIATION.—"Loading Rules" is the subject for discussion at the meeting at 8 p. m., on March 10 at the Engineering Societies Building, 29 West Thirty-ninth street, New York. The speaker will be H. L. Phyfe, Freight Container Bureau, Association of American Railroads. Motion pictures of impact tests made by the Freight Container Bureau will be presented. These show, graphically, methods of loading and how loads shift in cars.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

MACHINE SHOP PRACTICE DIVISION.—Erik Aberg, editor, Machinery, 148 Lafayette St., New York.

MATERIALS HANDLING DIVISION.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION.—M. J. Reed, 2 West Forty-fifth street, New York.

FUELS DIVISION.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

ASSOCIATION OF AMERICAN RAILROADS.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.

MECHANICAL DIVISION.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Annual meeting June 28, 29 and 30, at the Commodore Hotel, New York.

PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York.

MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4468 Oxford avenue, Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, Hotel Mayfair, St. Louis, Mo.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMEN'S ASSOCIATION.—Roy MacLeod, Room 127, G. O. Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of each month, except May, June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—F. T. James, general foreman, D. L. & W., Kingsland, N. J.

INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August, September, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately, excepting June in Los Angeles and October in Sacramento.

RAILWAY CLUB OF GREENVILLE.—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—P. A. Bissell, 40 Broad street, Boston, Mass.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, 1255 Old Colony building, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

TRAVELING ENGINEERS' ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

WESTERN RAILWAY CLUB.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

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Higher Degrees

of Superheated Steam

Are More Economical

Below are the results obtained from a locomotive on test. Note the increase in economy as the superheat increases:

STEAM TEMPERATURE	STEAM PER I.HP-HR.	SAVING IN STEAM From the Use of Superheat
Saturated Steam	28 lb.	——
150° Superheat	21 lb.	25.0%
200° Superheat	18 lb.	35.6%
250° Superheat	16 lb.	43.0%
350° Superheat	14 lb.	50.0%

The Elesco Type "E" superheater is a product of necessity.

It came into being as a solution to the exacting requirements demanded by steam locomotives of today. These requirements demanded a superheater that would deliver higher superheat and which would also contribute to an increased evaporation.

These requirements have been amply met by the Elesco Type "E" superheater, using a smaller size flue with a single loop unit.

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Superheaters • Exhaust Steam Injectors • Feed Water Heaters • American Throttles • Pyrometers • Steam Dryers

A minimum of structural change was involved in the stream-styling of the locomotive which hauls the "Asa Packer," the reconditioned train of the Lehigh Valley operating between Newark, N. J., and Mauch Chunk, Pa. The yellow-and-black finish of the cars is repeated on the locomotive

NEWS

Why Not Stop the Trains at the Crossings

A bill which would require attachment of "adequate" reflectors to each side of freight cars and unlighted passenger cars on steam railroads, which would be visible for 200 ft. to motorists approaching railroad crossings on unlighted highways, has been introduced into the New York State Assembly by J. H. Chase of Aurora, N. Y., and referred to the State Public Service Commission.

La Locomotive a Vapeur—A Correction

An error in transcription has been found in Part II of the review of André Chapelon's book in the January issue of the *Railway Mechanical Engineer*. The third conclusion in the first sentence of the third paragraph on page 4 reads: "the saving in heat is greater than the saving in water, and the saving in coal is greater than the saving in heat." This should read: "the saving in coal is greater than the saving in water, and the saving in water is greater than the saving in heat."

Survey Shows 56,311 Miles of Runs Better Than 60 m.p.h.

Published timetables of railroads in Canada and the United States at the end of 1938 listed a total of 924 separate passenger runs involving 56,311 route-miles scheduled at an average start-to-stop speed of a-mile-a-minute or better, according to tables compiled by Donald M. Steffee published in the February issue of "Railroad Magazine," of New York. Of these, 864 runs, totaling 47,087 route-miles, are covered daily, while the remainder are covered on a weekly or several-days-a-week basis. This record compared with that publicized by the same magazine eleven months previously in March, 1938, which showed 781 runs aggregating 46,242 miles, of which 38,532 were covered daily.

Reed and Cook Confirmed

The Senate on January 28 confirmed President Roosevelt's appointments of Mr. Roland Reed to the Railroad Retirement Board and George A. Cook to the National Mediation Board. The five-year term of the former, who succeeded James A. Dailey as the Retirement Board's "railroad" member, will expire August 29, 1943. Mr. Cook, a former secretary of the Mediation Board who succeeded to the membership of the late James W. Carmalt, will serve a term expiring February 1, 1942.

Equipment Repairs and Improvements

The Pennsylvania will recondition and streamline 100 of its passenger cars at its Altoona, Pa., shops.

The Canadian National is continuing its program of modernization and improvement of passenger equipment which has been carried on during the past few years. Work has been started to air-condition 76 additional cars in shops of the company, as follows: 20 coaches at Moncton, N. B.; 8 parlor cars, 2 compartment-observation-buffet cars, 3 diners at the Point St. Charles, Que., shops; 15 coaches at London, Ont.; and 28 sleeping cars at Winnipeg, Man. All principal trains of the National System are now completely air-conditioned, and the present program will enable the use of air-conditioned equipment on a number of trains of lesser importance.

The Western Pacific has spent more than $36,000,000 in an improvement program initiated in 1927. By the end of 1931, when the program was interrupted by the depression, $21,000,000 had been spent for the construction of new lines, new equipment and general improvements to roadway and rolling stock, and this figure was increased $15,250,000 in the last three years by additional expenditures of approximately $12,000,000 for road and equipment, and $3,250,000 for the purchase of locomotives and cars. During the last three years, the improvements have included the construction of a locomotive repair shop at Sacramento, Cal., at a cost of $500,000 in 1938; the purchase of eleven articulated freight locomotives and ten mountain type locomotives in 1938, and the purchase of 200 hopper cars, 200 steel box cars, 50 flat cars and a 200-ton capacity wrecking crane.

The Delaware, Lackawanna & Western will rebuild and remodel 10 steel coaches formerly used in suburban train service. The coaches will be equipped with vestibules, for use in through trains over the main lines. A dining car and a buffet-club car also will be rebuilt and redecorated throughout, including the installation of air-conditioning equipment in the company's shops at Kingsland, N. J. It is expected that the cars will be ready to handle World's Fair traffic.

The Illinois Central during 1939 will build in its shops at Milwaukee, 1,000 50-ton all-steel box cars and 75 steel caboose cars. Six Diesel-electric switching locomotives costing in excess of $400,000 will be acquired under a lease purchase plan. No new passenger cars will be built, but a number of existing cars will be remodeled and air conditioned. Changes will also be made in the road's wheel foundry at Milwaukee, Wis.

British Train to Run 3,121 Miles

A NEW "Coronation Scot," latest streamliner of the London Midland & Scottish, recently arrived in Baltimore, Md., aboard the special railway-equipment-carrier "Belpamela" and is being prepared for a 3,121-mile tour through the eastern United States before being exhibited at the New York World's Fair.

The cars of the "Coronation Scot" which will make the tour comprise one of three completely new train sets recently constructed by the L. M. S. They differ from the original "Coronation" equipment placed in service in 1937 principally in the introduction of articulation and the use of light-weight high-tensile steel. Also, the color scheme is that of the standard L. M. S. lake with gold lining, as contrasted with the blue and silver coronation colors of the "Coronation Scots" now in regular service.

The tour "Scot" equipment consists of eight cars, one of which is a first-class sleeper, as compared with a consist of nine cars in the regular day service trains. The sleeper has been added to the normal consist to show the American public the latest type of accommodations on British night trains. The cars to be on exhibition, in order from the locomotive, are (1) corridor first-class coach with baggage facilities, (2) corridor first-class coach, (3) corridor first-class lounge car with bar, (4) first-class diner, (5) kitchen car, (6) third-class diner; (7) first-class sleeping car; and (8) club-salon car. The tour train has a seating capacity of 173 and weighs 586,880 lb. without locomotive.

The locomotive which will haul the exhibition is "Coronation" No. 6220, one of five identical streamlined "Pacific"-type engines built by the road for "Coronation Scot" service. Representing practically the limit of power and size possible within the limits of British railway clearances, it weighs 368,260 lb. and has an overall length of 73 ft. 9.75 in. Its drivers are 6 ft. 9 in. in diameter, and at 85 per cent of its 250 lb. per sq. in. boiler pressure it exerts 40,000 lb. tractive force. The six-wheel tender carries 4,000 gal. of water and 22,400 lb. of coal and is fitted with a steam-operated coal pusher. In regular service the locomotive picks up water at speed from 11 track pans between London and Glasgow, but for the American tour has been specially fitted to take water from standard water columns. An American headlight and bell have also been added for the tour.

Equipment Installed in 1938

CLASS I railroads of the United States in 1938 installed 18,517 new freight cars in service, according to complete reports for the year made public on January 23 by the Association of American Railroads. This was a decrease of 56,541 compared with the number of such installations in 1937 and a decrease of 25,424 compared with 1936. Class I roads also put in service in 1938 164 new steam locomotives and 118 Diesel-electric locomotives.

The 1938 installations of new freight cars included: coal, 5,195; box, including both plain and automobile, 10,530; refrigerator, 43; flat, 1,529; stock, 496; and miscellaneous, 724.

New freight cars on order on January 1, this year, totaled 5,080 compared with 7,947 on January 1, 1938. New steam locomotives on order on January 1, totaled 30 compared with 131 on January 1, 1938. New electric and Diesel-electric locomotives on order at the beginning of this year totaled 41 contrasted with 30 at the beginning of 1938.

New freight cars and locomotives leased or otherwise acquired are not included in the above figures.

Rehabilitation Will Require Expenditure of $2,000,000,000

THE expenditure of approximately $2,000,000,000 is necessary to replace and repair the railroads' equipment and bring the number of units up to the total of 1926, according to a statement made by Walter M. W. Splawn, member of the Interstate Commerce Commission, in an address before the Bankers Club of Chicago on January 31. "The rehabilitation of way and equipment," he said "is more needed by some companies than by others. A large percentage of locomotives, passenger cars, and freight cars are in need of repair, modernization, or replacement. It is estimated that it will cost nearly $2,000,000,000 to accomplish this end and bring the number of units up to 1926. If this were done, it is estimated that it would increase the capacity of the railroads 40 per cent above 1937 and 13 per cent above 1929. Obviously, this entire expenditure is not justified by the traffic now available. But, going from one company to another, one will find varying degrees of justification for such expenditures. Some companies can make such a good showing that they can repay loans for such a purpose."

10,977 Air-Conditioned Cars

CLASS I railroads and the Pullman Company had 10,977 air-conditioned passenger cars in operation on January 1, according to reports made public February 20 by the Association of American Railroads. This was an increase of 652 compare with the number of air-conditioned passenger cars on January 1, 1938. Of the total number of such cars, Class I railroads on January 1 this year had 6,022, an increase of 458 compared with the same date last year. The Pullman Company on January 1 this year had 4,955 air-conditioned passenger cars in operation which was an increase of 194 compared with January 1, 1938.

C. & E. I. Dedicates New Shops

DEDICATION ceremonies marking the opening of the new coach shops of the Chicago & Eastern Illinois at Danville, Ill., were held on February 2. The new coach shops, which replace those destroyed by fire last year, are 417 ft. long and 110 ft. wide. The building houses a coach paint shop served by four tracks and a coach repair shop with six tracks. Between these are located shops for woodworking, up-

(Continued on second left-hand page)

New Equipment Orders and Inquiries Announced Since the Closing of the February Issue

LOCOMOTIVE ORDERS

Company	No. of Locos.	Type of Loco.	Builder
Ferrocarril de Antioquia (Colombia)	2	2-8-2	Baldwin Loco. Works
Ford Motor Co.	3	1000-hp. Diesel-electric	General Electric Co.
Mexican Gov't Railways	2	500-hp. Oil-electric	General Electric Co.
Southern Pacific	28	4-8-8-2 (oil)	Baldwin Loco. Works
	12	2-8-8-4 (coal)	Lima Loco. Works
Union Pacific	15	4-8-4	American Loco. Co.

LOCOMOTIVE INQUIRIES

Company	No. of Locos.	Type of Loco.	Builder
Atchison, Topeka & Santa Fe	30	Diesel-electric	....
C. R. I. & P.	10	20,000-gal. tenders	....

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Lehigh & New England	100	Covered hoppers	Bethlehem Steel Co.
Union Pacific	2,000	Box	Company Shops
U. S. Navy Dept.	2	Flat	Magor Car Corp.
	2	Box	Greenville Steel Car Co.

FREIGHT-CAR INQUIRIES

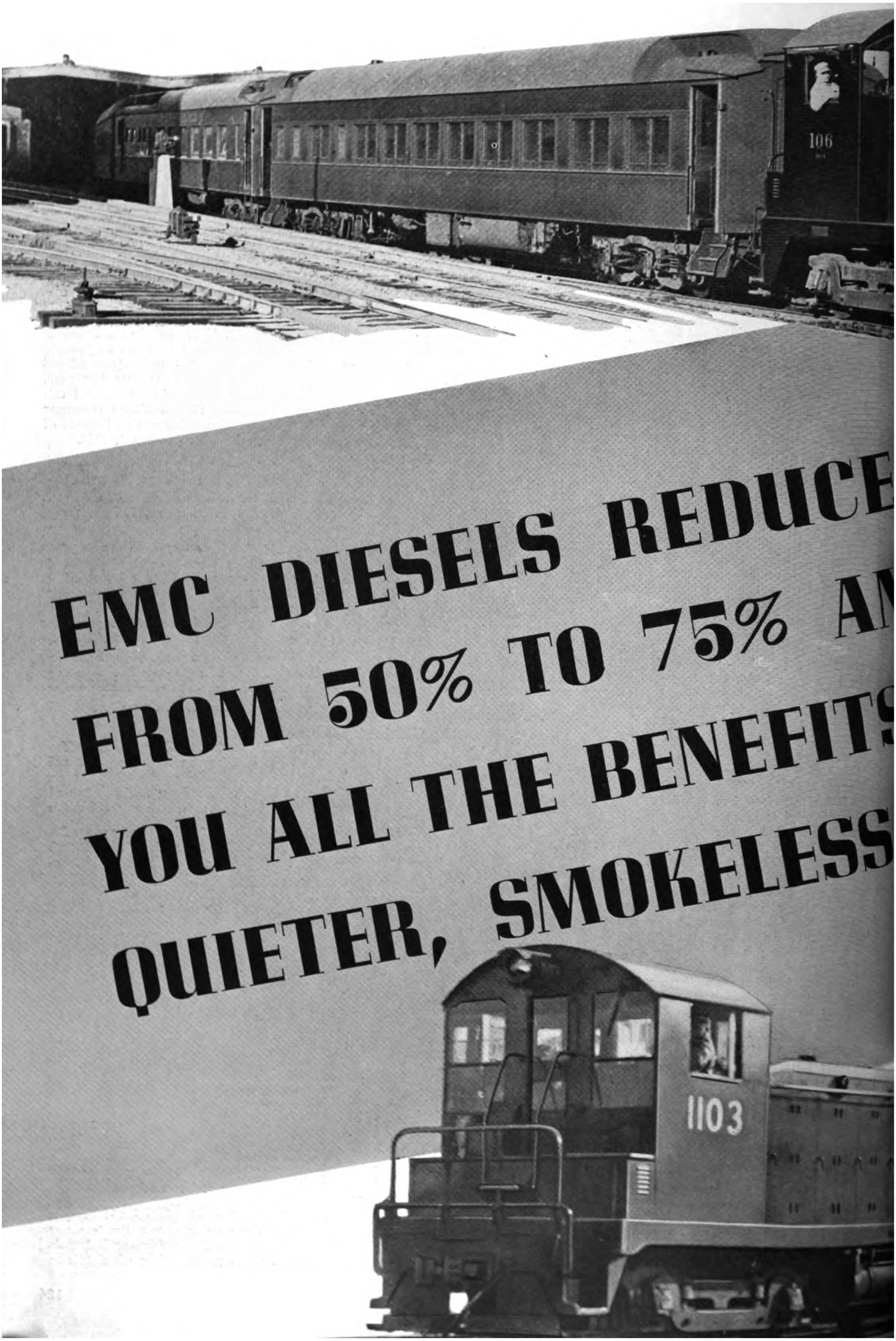
Road	No. of Cars	Type of Car	Builder
C. & N. W.[1]	900	Freight	....
Ill. Central	1,000	Hopper	....
Maine Central	500	40-ton box	....
	150	Twin hopper	....
	100	Gondolas	....
Missouri-Illinois	25	50-ton gondola	....
	125	50-ton box	....
Missouri Pacific	1,000	Gondolas	....

PASSENGER-CAR INQUIRIES

Road	No. of Cars	Type of Car	Builder
C. R. I. & P.		See footnote 2	....
Delaware & Hudson	6	Light-weight coaches	....
Missouri Pacific	2	Mail-storage	....
	2	Mail-bagg.	....
	2	Coaches	....
	2	De luxe coaches	....
	2	Diner-bagg.-lounge	....
	2	Parlor-observa.	....

[1] Purchase under consideration.

[2] The Rock Island is inquiring for two or seven streamlined trains. Two of the trains, to be used between Chicago and Denver, Colo., will each contain a 2,000 hp. Diesel-electric locomotive, one baggage car, two coaches, one dining car, two sleeping cars and one observation lounge car. These trains, to be known as the Colorado Rockets, will operate on a schedule faster than that of the Rocky Mountain Limited. They will run from Chicago to Limon, Colo., where they will be divided, one train running to Colorado Springs, and the other to Denver.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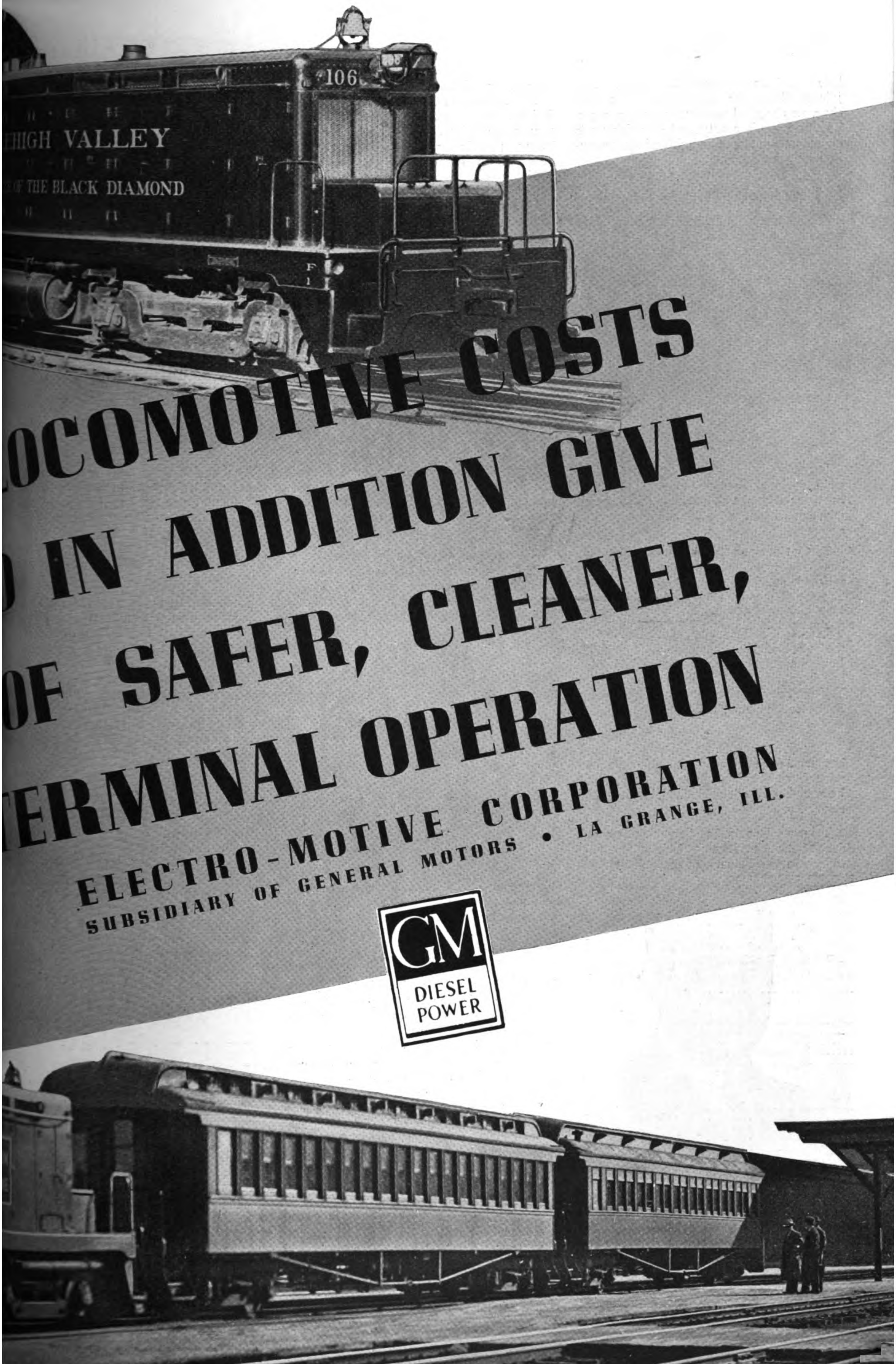
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HIGH VALLEY
OF THE BLACK DIAMOND
OCOMOTIVE COSTS
IN ADDITION GIVE
OF SAFER, CLEANER,
ERMINAL OPERATION
ELECTRO-MOTIVE CORPORATION
SUBSIDIARY OF GENERAL MOTORS • LA GRANGE, ILL.
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holstery, brass, paint and varnish. Adjoining the coach repair shop is a pipe shop, an electrical shop and a battery room. The building is constructed of brick walls on concrete foundations with window openings of glass block.

New Fuel Efficiency Record

A NEW record in fuel efficiency in freight service was established by the railroads of the United States in 1938, according to J. J. Pelley, president of the Association of American Railroads. In that year an average of 115 lb. of fuel was required to haul 1,000 tons of freight and equipment a distance of one mile. This was the best average ever attained by the railroads since the compilation of these reports began in 1918.

The average in 1938 was a reduction of 33.1 per cent compared with 1920, in which year it was 172 lb. It also was a reduction of two pounds compared with 1937 and a reduction of four pounds compared with 1936.

For each pound of fuel consumed in freight service, the railroads in 1938 hauled 8.7 tons of freight and equipment a distance of one mile, which also was the best average that has ever been established. In 1937 the average was 8.6 tons, but in 1920 it was only 5.8.

In the passenger service, the railroads in 1938 used 14.9 lb. of fuel in order to haul a passenger-train car one mile. This was a decrease of one-fifth pound compared with 1937 and a decrease of two-fifths pound compared with 1936. Fuel efficiency in the passenger service, using the same basis of compilation, was nearly 21 per cent better in 1938 than in 1920 when the average was 18.8 lb.

Improvements in the construction of new locomotives, modernization of old locomotives, continued progress in scientific methods of treating boiler water in order to eliminate so far as possible ingredients harmful to locomotives, and improved methods of railroad operation have been among the factors responsible for the almost constant increase in fuel efficiency that has taken place on the railroads of this country in the past twenty years, the statement says.

Supply Trade Notes

LEM ADAMS, chief engineer of the Oxweld Railroad Service Company, Chicago, has been elected vice-president, with headquarters as before in Chicago.

◆

T. C. COLEMAN & SON, Louisville, Ky., has been appointed representative of the railroad sales division of the Cleveland Tractor Company, Cleveland, Ohio.

◆

JAMES W. SEABOUGH, Jr., formery in the mechanical department of the St. Louis-San Francisco, at Springfield, Mo., has been appointed sales engineer of the T-Z Railway Equipment Company and the Brewster Company, Chicago.

◆

THE STANDARD STEEL WORKS COMPANY has transferred its general sales department from Burnham, Pa., to The Baldwin Locomotive Works office building at Eddystone, Pa.

◆

THOMAS DREVER has been elected president of the American Steel Foundries, Chicago. In the February issue of the *Railway Mechanical Engineer* it was incorrectly stated that Mr. Drever had been elected vice-president and treasurer, whereas that is the position he has just vacated.

Thomas Drever

KEITH C. BOWERS of the St. Louis office of Revere Copper and Brass, Incorporated, Chicago, has been appointed sales representative for Western Missouri and Kansas, with headquarters at Kansas City, Mo.

◆

B. C. BROWNING has been appointed national railway representative of Oakite Products, Inc., with headquarters in the Wrigley building, Chicago. Mr. Browning has been associated with the Oakite service organization for the past 10 years. During his first few years he was a representative in Oklahoma territory, concentrating principally on oil refinery and railroad work. Since 1935 his entire time has been devoted to the railway field.

B. C. Browning

◆

J. R. SEXTON, formerly with the Safety Car Heating & Lighting Co., has been appointed sales manager, western division, for The Standard Stoker Company, Inc., with headquarters at Chicago.

◆

THE FLEXROCK COMPANY has moved its general office and plant from 800 North Delaware avenue to larger quarters at Twenty-third and Manning streets, Philadelphia, Pa.

GEORGE W. MORROW, for the past 13 years a sales representative of the Ingersoll-Rand Company, in Chicago, in charge of maintenance of way and bridge and building equipment sales, has been appointed general sales manager of the Reade Manufacturing Co., Inc., Jersey City, N. J.

◆

JOHN F. DEEMS has joined the staff of the Edna Brass Manufacturing Company as vice-president in charge of sales and sales developments. Mr. Deems will have his headquarters in Cincinnati, Ohio, where the general offices and main plant are located. He was born at Tupper Lake, N. Y., and is a graduate of Columbia University. His railroad experience included service in various capacities on the Lehigh Valley, the Baltimore & Ohio, the Delaware & Hudson, and the Delaware, Lackawanna & Western. For the past five years Mr. Deems had been associated with the Union Asbestos & Rubber Co.

J. F. Deems

◆

D. R. ARNOLD has been appointed vice-president of the Standard Railway Equipment Company in charge of sales of eastern and southeastern territories with headquarters at 247 Park Ave., New York. He succeeds Samuel G. Rea, deceased.

J. H. Schroeder, assistant to vice-president, with headquarters at Chicago, has been transferred to New York.

◆

J. T. WHITING, vice-president of the Alan Wood Steel Company, Conshohocken, Pa., has been elected president, and C. E. Davis, assistant to the vice-president, succeeds Mr. Whiting as vice-president. Clement B. Wood, formerly chairman of the board and president, remains as chairman of the board.

◆

JOHN W. LOHNES, for the past three years in the office of the Vanadium Corporation of America, at Chicago, has been appointed assistant to the general manager of sales, with headquarters at 420 Lexington avenue, New York. Prior to his association with the Vanadium Corporation of America, Mr. Lohnes was associated with the Carnegie-Illinois Steel Corporation, at Chicago.

Obituary

ALLEN E. OSTRANDER, assistant vice-president of the American Car and Foundry Company, died suddenly at a hotel in New York City on February 5. He was born on June 23, 1877, at New Haven, Conn., and was educated in the New Haven public schools, received private tuition and took courses at Yale University. Mr. Ostrander entered railway service with the New York, New Haven & Hartford, serving successively as messenger, yard clerk, shop apprentice and draftsman. All except the last position were pursued during school vacations. He then served as a draftsman for Cornelius Vanderbilt, detailing patented devices for locomotives and cars. Subsequently, Mr. Ostrander joined

Allen E. Ostrander

the Standard Steel Car Company as draftsman and squad leader. In 1903, as a designer, he entered the employ of the American Car and Foundry Company and served as estimator, later as chief estimator and then as mechanical engineer until 1915, when he was appointed general mechanical engineer. In 1924 he was transferred to the sales department as assistant vice-president. Mr. Ostrander was a member of a number of technical organizations, including the American Society of Mechanical Engineers.

◆

EDWARD H. DEWSON, who was relieved of active duties as district engineer at New York of the Westinghouse Air Brake Company in January, 1922, and since that time served as consulting engineer of the company, died in St. Joseph's Hospital, Tampa, Fla., on February 9, from injuries received a few days previously in an automobile accident.

◆

JAMES F. COSGROVE, for many years manager of service in the railroad division of the Worthington Pump & Machinery Corporation, died on January 21, at his home in East Orange, N. J., after a brief illness. A native of Madison, Wis., Mr. Cosgrove was graduated from the University of Wisconsin with an engineering degree. He afterward joined the faculty of the National School of Electricity in Chicago, and later, for 23 years, was on the faculty of the International Correspondence School at Scranton, Pa., being the author of several textbooks on combustion of coal and the firing of locomotives. He had been associated with the Worthington Pump & Machinery Corporation since 1923.

Personal Mention

General

T. C. HUDSON, general superintendent of the Montreal district of the Canadian National at Montreal, Que., has retired. Mr. Hudson was born at Brockville, Ont., and began his railroad career as a call boy with the Canadian Pacific at Carleton Junction in 1886. He served successively as machinist apprentice, machinist, chargehand and erecting-shop foreman, until 1906,

T. C. Hudson

when he was appointed locomotive foreman at Ottawa, Ont. In 1907, he joined the Canadian Northern Ontario as foreman at Parry Sound, Ont., and later in the same year was appointed master mechanic at Shawinigan Falls, Que. In 1908, he was transferred to Quebec and to Joliette, Que., in 1910 in the same capacity. With the formation of the Canadian National Railways in 1918 Mr. Hudson was appointed general master merhanic, Eastern lines, with headquarters at Montreal. When the amalgamation of the Canadian National-Grand Trunk Railways took place in 1923, Mr. Hudson was appointed assistant general superintendent of motive power, Central regiòn, at Toronto. He remained in this position until June. 1929, when he was appointed general superintendent of operation, Southern Ontario district. In June, 1936, he became general superintendent of the Montreal district. During the World War he was in charge of locomotives handling all trains for troop movements to and from Valcartier. Mr. Hudson is a past president of the Canadian Railway Club of Montreal and of the International Fuel Association, Chicago. He also assisted in the formation of the Railway Club in Toronto and was elected its first president in 1931.

Car Department

ORLIN H. CLARK, supervisor of car repair bills of the Missouri Pacific at Houston, Tex., has been promoted to the position of general car inspector with headquarters at Houston.

U. E. BERNECKER has been appointed general car foreman of the Pere Marquette, with headquarters at Flint, Mich., succeeding A. B. Bailey, deceased.

ALLEN D. WELCH has been promoted to the position of car foreman of the shops of the Chesapeake & Ohio at Handley, W. Va.

Shop and Enginehouse

J. MILNE, boiler foreman of the Canadian National at Edmonton South, Alta., has retired.

J. HAWTHORNE, boiler foreman of the Canadian National at Melville, Sask., has been appointed boiler foreman at Edmonton South, Alta.

A. M. MUCKLE, locomotive foreman of the Canadian National at Portage La Prairie, Man., has been appointed locomotive foreman at Swan River, Man.

P. H. MALEY has been appointed general boiler inspector of the Chicago Great Western, with headquarters at Oelwein, Iowa.

H. B. MAY, locomotive foreman of the Canadian National at Swan River, Man., has been appointed locomotive foreman at Portage La Prairie, Man.

STEPHEN J. MCDONALD has been appointed acting day locomotive foreman of the Canadian National at Point Tupper, N.S.

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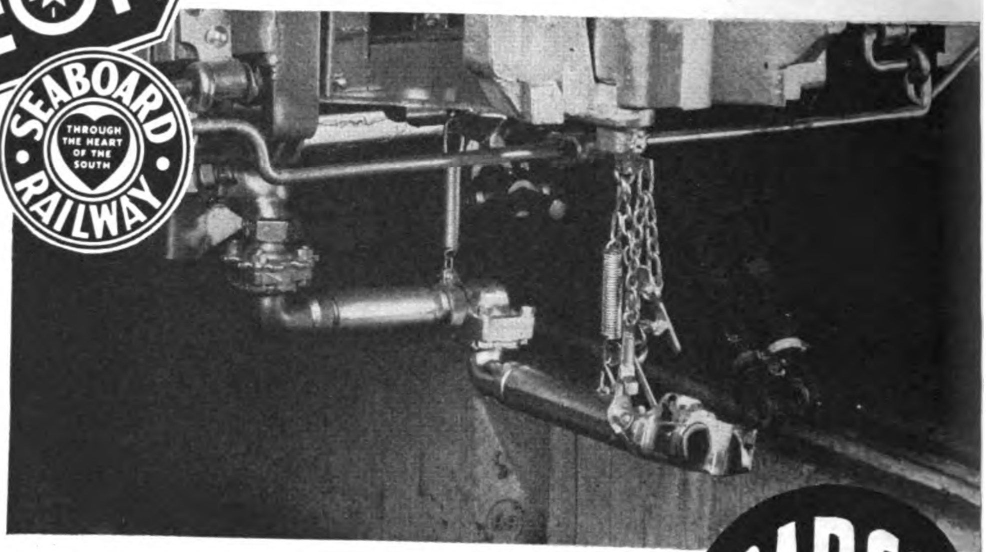

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See page 127.

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April, 1939

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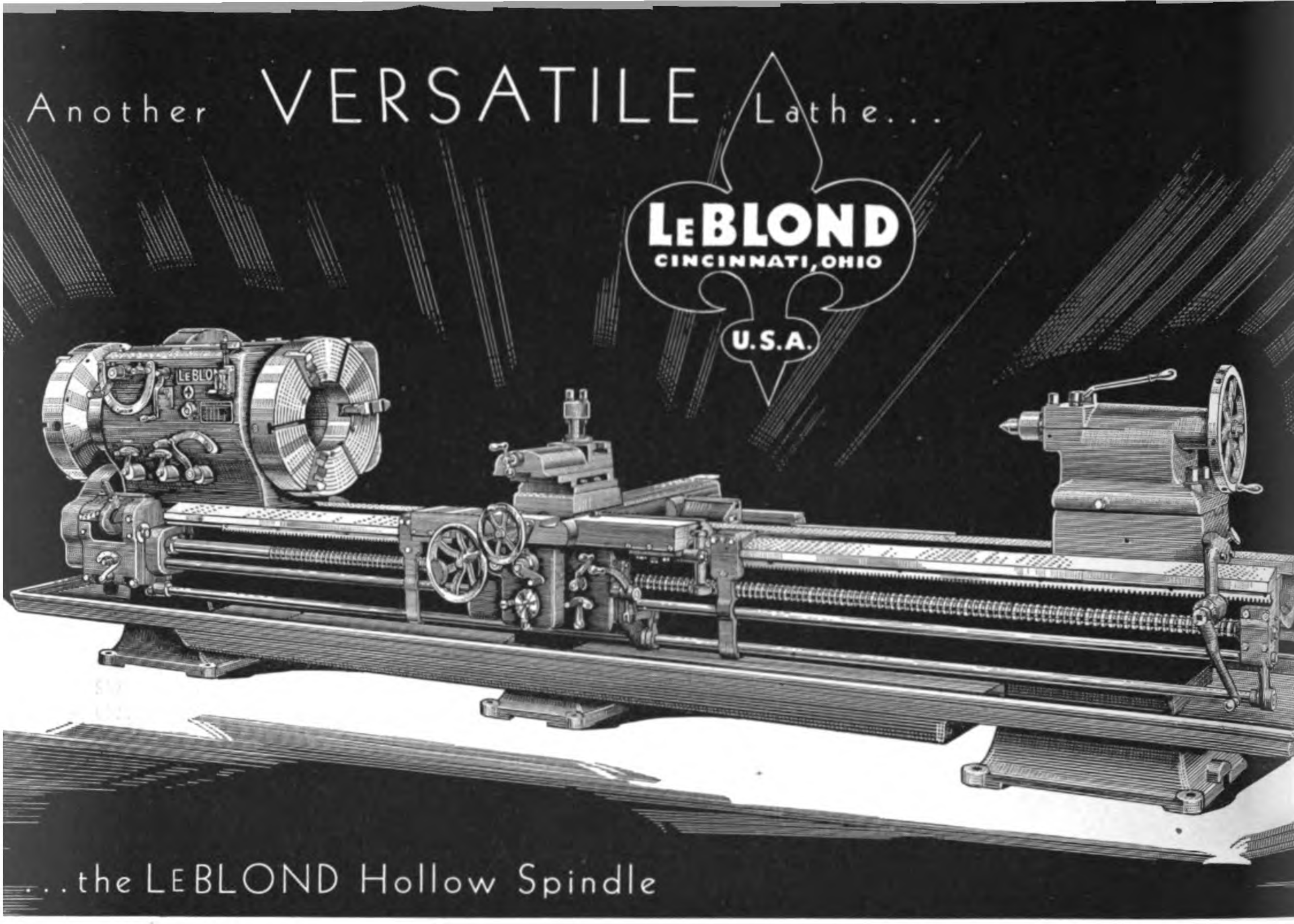

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The Seaboard Air Line "Silver Meteor"

The Seaboard Air Line Inaugurates

The "Silver Meteor"

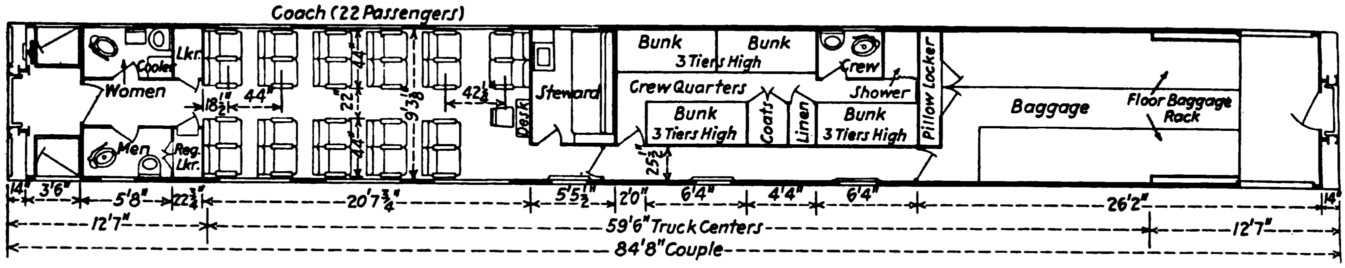
Budd-built stainless-steel streamline train provides seats for 280 coach passengers in New York-Florida service—The train is hauled by an Electro-Motive 2,000-hp. Diesel-electric locomotive

On February 2 the Seaboard Air Line inaugurated a de luxe chair-car service between New York and Florida when the "Silver Meteor" made its first southbound trip to Miami. The train consists of seven air-conditioned cars of lightweight stainless-steel construction, built by the Edward G. Budd Manufacturing Company. It has reclining chair-car seats for 280 passengers. The facilities include dressing-room lounges for men and women, a diner, a tavern, and an observation-lounge. The train is handled by a Pennsylvania electric locomotive between New York and Washington. From Washington to the southern termini the motive power is a 2,000-hp. Diesel electric engine built by the Electro-Motive Corporation. The train makes a round trip each three days, alternating between New York and Miami and New York and St. Petersburg.

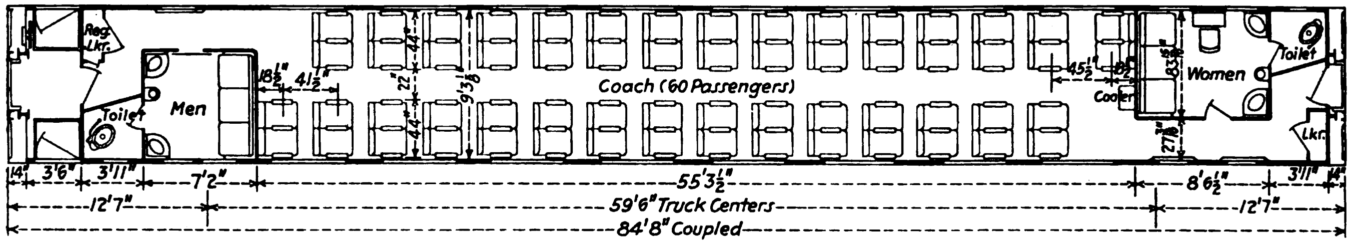
The Structures and Mechanical Features

This train of stainless-steel construction, welded to form an integral unit by the Budd Shotweld method, has stainless-steel end underframe and body bolsters, and a stainless-steel center sill of unusual strength extending between the end sills. This center sill is built up of stainless-steel shapes drawn from sheets of $\frac{1}{4}$-in. and $\frac{3}{16}$-in. material. It has a cross-sectional area of 18.06 sq. in. and is designed to take a buffing load of 900,000 lb. within the limits of working stresses. The sill is symmetrical about both its horizontal and vertical axes and the line of draft falls on the center of gravity of the cross-section. The floor structure consists of beams, stringers, and corrugated floor sheets, all integrally welded together and to the truss-type side frame. The roof and skirt sheathing is corrugated high-tensile stainless steel, the deadlight panels are flat panels of soft finish, the rails are brightly polished, and the area below the belt rail is fluted panels, all of which form an attractive exterior of various finishes of the stainless steel. The railroad name is painted on the letterboard name plate and the car numbers are etched on a satin-finish stainless-steel plate in the fluted panel area.

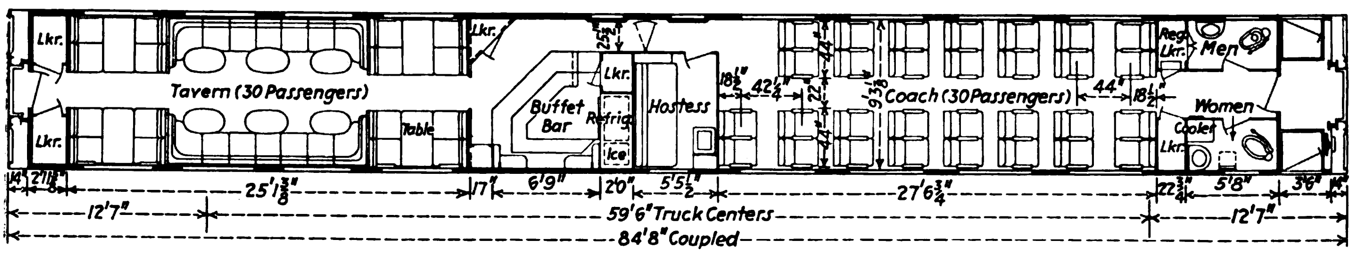
The diaphragms of stainless steel have an inner telescoping arrangement sealed all around with canvas. The outer diaphragm of rubber is held taut by a frame hinged



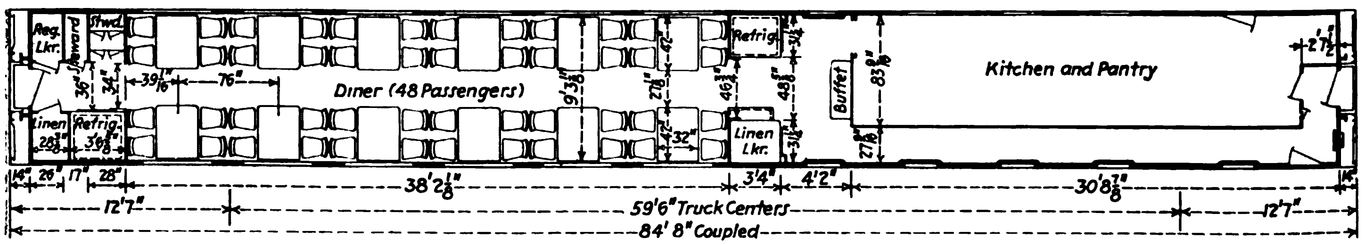
The baggage-chair car contains a steward's room and sleeping quarters for a crew of twelve



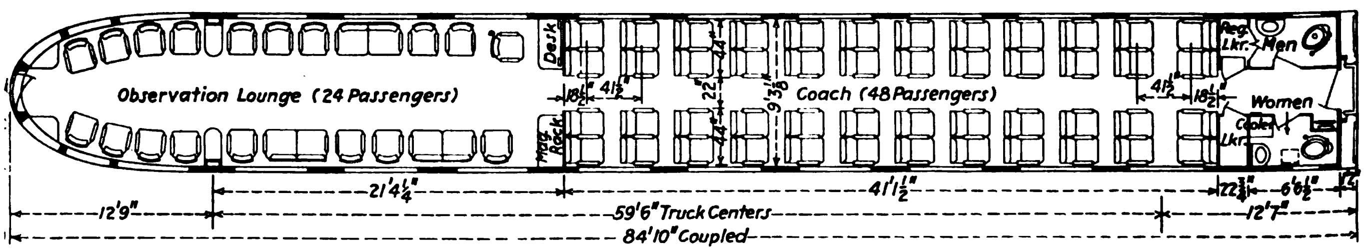
One of the three sixty-passenger coaches



The chair-tavern car — The hostess' room is in this car



Each table in the diner seats four



The chair-observation-lounge car

from the face plate to give a continuous streamline appearance. At each vestibule there is a swing-out sign with the car designation number for the guidance of passengers when the train is at a station. The vestibule steps, when in the closed position, retain the continuity of the exterior sheathing.

All the cars are non-articulated and have four-wheel, double-equalized trucks with 9-ft. wheel base, Timken roller bearings, General Steel castings, unit frames, Houde shock absorbers and rubber sound deadening at vital points. Wheels and axles were furnished by the Bethlehem Steel Company. The wheels are 36 in. in diameter. With the exception of the leading truck of the combination baggage-chair car and both trucks of the dining car, which have 6-in. by 11-in. journals, the journal sizes are all 5½ in. by 10 in. The maximum axle load on the most heavily loaded 6-in. by 11-in. truck is slightly less than 36,000 lb.; on the 5½-in. by 10-in. trucks it is under 30,000 lb. The trucks are fitted with Simplex unit cylinder clasp brakes and automatic slack adjusters. National tight-lock couplers and double-acting rubber-type draft gears assure smooth starting without passenger discomfort.

The cars are equipped with New York D-22-A auto-

matic passenger brake equipment. This equipment includes the D-22-A control valve and the A-4-A relay valve. With foundation brake rigging designed to provide the required high braking force for ultra high-speed service the A-4-A relay valve normally functions to provide the standard maximum braking ratio of 150 per cent for conventional passenger service, but permits the later adoption of high-speed features with a minimum of change if this becomes desirable.

Each car has a Safety 20-kw. body-hung, axle-driven generator and Exide 32-volt, 1,000-amp.-hr. batteries carried in stainless-steel battery boxes. Hinged skirt panels permit access to the under-car apparatus for servicing. Standby receptacles provide for battery charging and operation of the air-conditioning apparatus at terminals.

All passenger sections are air conditioned with Frigidaire electro-mechanical apparatus and the car bodies are insulated with Stonefelt throughout. The compressor equipment is located beneath the floor of the car and overhead is mounted the combination cooling and heating unit. The conditioned air is distributed by an overhead duct with diffusers. Fulton Sylphon thermostatically controlled side-wall radiation supplements the overhead heating unit. Barco insulated flexible steam-heat connections are installed between the cars.

The water supply is carried in stainless-steel tanks under the car which are serviced from filling plugs at the side.

Interior Arrangements of the Cars

All cars are 84 ft. 8 in. in length, coupled, except the observation car which is 84 ft. 10 in. The train consists of—

Car. No.
1—Baggage-chair car
2—60-passenger chair car
3—Chair-tavern car
4—48-passenger diner
5—60-passenger chair car
6—60-passenger chair car
7—Chair-observation lounge car

There are 280 revenue seats, 120 non-revenue seats in the diner, tavern, observation lounge, and chair-car lounges, and sleeping accommodations for a crew of 14.

The first car has a 26-ft. 2 in. baggage compartment with letter case and drop-leaf desk, and at the rear is a locker for the storage of pillows. The side lining of the baggage compartment is corrugated steel sheets above which on the side ceiling are flat steel sheets and a tempered Masonite top ceiling. The ceiling is painted white, the side walls buff and the hardware black.

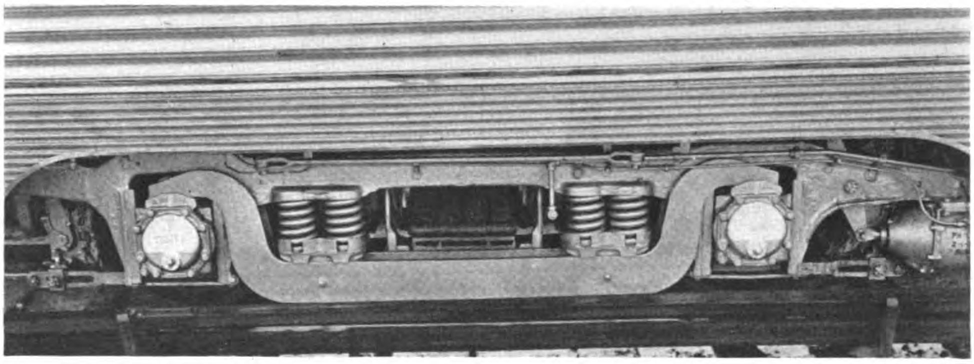
Back of the baggage section is the crew's quarters with sleeping accommodations for 12 men in bunks three tiers high. The facilities include a shower bath, toilet and washing facilities, wardrobe and linen lockers. The shower stall is lined with stainless steel and the floor consists of a rubber mat on a wood rack set in a stainless-steel drain pan. The steward has a private stateroom with complete toilet and sleeping accommodations. Wall sockets permit a folding type table to serve as a desk.

The balance of this car is a 22-passenger chair section with a conductor's desk at the forward end and men's and women's toilet rooms at the rear.

Car No. 2 is a 60-passenger chair car with the vestibule forward and has large men's and women's lounges at opposite ends of the car. Against the partition of the women's lounge is a console-type electric water cooler, presenting an attractive setting with a photo mural above. Cars Nos. 5 and 6 are duplicates of No. 2, except for the direction of operation of No. 5.

The dining car

Car No. 3, the chair-tavern car, has a 30-passenger chair section with toilet rooms and vestibule forward. The room for the hostess at the rear has sleeping and toilet equipment similar to the steward's room of car No. 1.



One of the four-wheel equalized trucks

The tavern section has two longitudinal settees, each with three pedestal-type tables. Forward and back of the settee on either side are pairs of facing seats with a table arranged for card playing.

Lighting is by three-unit and two-unit ceiling fixtures and built-in lights over the windows.

The bar at the front of this section has decoratively

etched gun-metal back-bar and side-bar mirrors with diffused side lighting, glass shelves, a black rubber bar top and black molding. It is equipped with electric refrigeration and has a concealed radio to supply music for the patrons of the tavern section.

The diner, car No. 4, seats 48 at double tables, six on each side of the aisle. The chairs have aluminum frames. Lighting consists of ceiling fixtures and concealed over-window lighting.

Against the kitchen partition facing the dining room is the buffet with a vertical-grain Caucasion walnut veneer

A coach interior

on the cabinet body and vertical-grain Aricutal-walnut-veneered door and drawer panels. Above is a mirror.

The kitchen has bright chrome-plated piping and fixtures and stainless-steel lining and lockers. Complete equipment for efficient service includes the range with an automatic blower, electric dish washer, electric ice-cream cabinet, sinks, work tables, etc. The kitchen flooring is wood racks set in stainless-steel drain pans. The windows are drop type with opal glass, and a service door permits provisions to be taken directly into the kitchen. From a slot on either side of the entrance to the pantry is blown a curtain of air which is drawn inward by the ceiling exhaust fans. The air curtain prevents food odors from passing into the dining room.

The last car, the chair-observation-lounge, has a 48-

Weights of the Cars in the Seaboard Air Line "Silver Meteor"

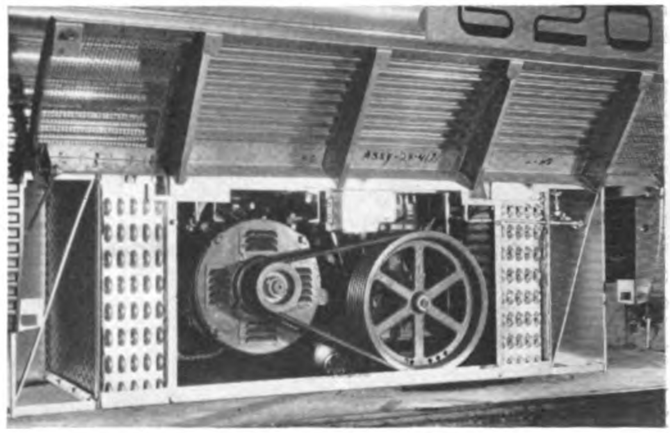
	Body				
	Dry wt., lb.	Ready for service, lb.	Trucks lb.	Total, ready to run, lb.	Revenue load, lb.
Coach-baggage	69,161	72,911	35,050	107,961	22,900
60-passenger coach ..	66,460	68,130	34,600	102,730	9,000
Coach-tavern	69,911	72,731	34,600	107,331	9,150
Diner	75,312	88,412	35,475	123,887	7,100
Coach-observation ..	63,501	65,171	34,900	100,071	10,802

passenger chair section with the smaller type toilet rooms forward. The observation lounge has 17 movable satin-finished square-tubular-framed arm chairs, three love seats, and a desk chair.

Between the chair section and observation-lounge section is a low partition with decorative plate glass above. Etched in each panel is a large game fish, seen as through the side of an aquarium. Against this forward partition is a writing desk on the left and on the opposite side a magazine rack with a built-in radio. Toward the rear of the lounge are two built-in side tables and on either side of the rear-end doors is a built-in table, one of which conceals the equipment for train back-up movements.

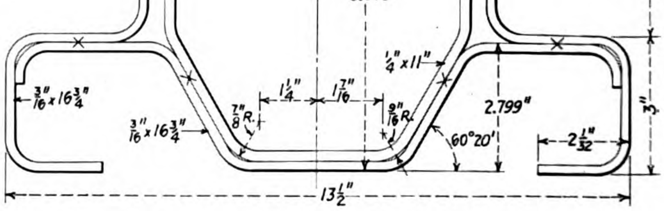
The lighting is by overhead fixtures, continuous cove lighting over the windows and table lamps.

In the passenger sections throughout the train the interior lining is, in general, Masonite. The flooring consists of cork strips set in the corrugated-steel structural



The air-compressor and condenser unit

floor, on the top of which is one inch of cork which serves as heat and sound insulation. The passenger sections are all fitted with continuous closed-type bag racks, on the under side of which are built-in reading lights, individually controlled by the occupants of each seat. The Heywood-Wakefield seats are rotating and reclining to several positions. They have Dunlopillo foam-rubber seat cushions and backs of hair-filled inner-spring construction, stainless-steel foot rails, and upholstered arm rests. In all of the chair-car sections there are four positions where portable wall-type tables, each with an



Center-sill cross-section used on the Silver Meteor cars

aluminum-edged rubber-surfaced top, and a folding leg may be set up.

The window posts are spaced 61 in. apart which permits windows wide enough to accommodate two seats each. All side windows are double glazed with polished plate glass on the outside and laminated safety plate glass on the inside. The sashes are of extruded aluminum and are fitted with moisture-absorbing cartridges to prevent fogging of the inner surfaces.

In all of the coach sections the general lighting is by recessed ceiling fixtures, in each of which is incorporated a small blue lamp to supply a dim, restful light during the night hours. The individually controlled luggage-rack fixtures furnish illumination for reading. All toilets and lavatories are equipped with porcelain wash basins and foot-operated pressure-fed double-pan hoppers, and all exposed piping is chrome plated. Each men's room has a 100-volt a.c. outlet for electric razors and each women's room has a folding drop seat.

Each chair-car section has its own individual color scheme. These are designated as the green, the coral, the brown, the blue, and the pink cars, based on the predominate note in the decorations. Each, however, is made up of a number of harmonizing, but contrasting, tones, involving ceilings, side walls, upholstery, and floor. On the bulkheads at the end of each chair-car section are large photo murals in stainless steel frames. Common to all of the cars are the Pantasote window shades, the inside faces of which are beige, and the floors under the seats, which are in dark oak.

The floors of the tavern, the observation lounge and the diner are carpeted. In these sections the windows are also softened with drapes.

The Locomotive

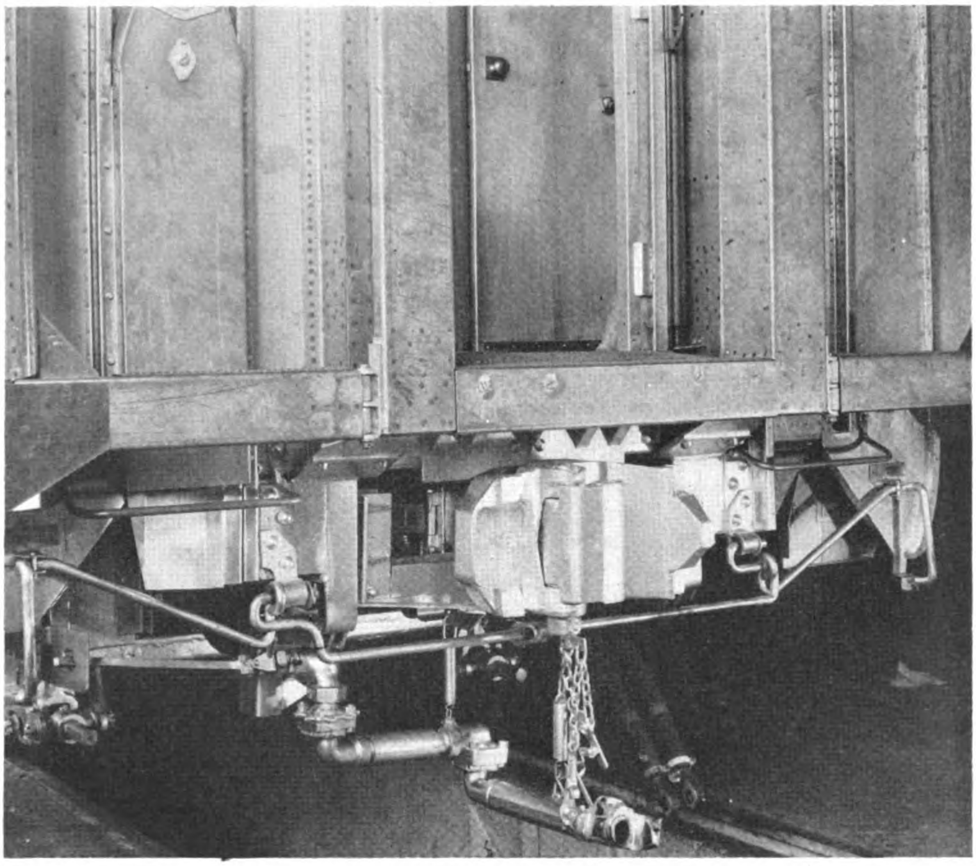
The locomotive for the Silver Meteor is a 2,000-hp. Diesel-electric unit built by the Electro-Motive Corporation, La Grange, Ill. In all of its important essentials it is identical in design to the "A" units of the 6,000-hp. locomotive built by the same company for the Orange Blossom Special which went into service on December 15, 1938.

The power plant consists of two 1,000-hp. General Motors 12-cylinder, two-cycle Diesel engines controlled simultaneously from the main throttle. To each main engine is connected a 600-volt d.c. generator which supplies the electrical energy for the 450-hp. traction motors in the truck directly below each power plant. The electrical equipment was supplied by the Electro-Motive Corporation.

The locomotive is 70 ft. 4 in. long over the coupler pulling faces and weighs 315,700 lb. in working order. This weight is carried on two six-wheel trucks—157,350 lb. on the front truck and 158,350 on the rear truck. The front and rear axles of each truck are geared to the traction motors. The truck assemblies are interchangeable with the locomotives used on the Orange Blossom Special. They weigh approximately 50,000 lb. and have a wheel base of 14 ft. 1 in. The wheels are 36 in. rolled steel and the axles are mounted in Hyatt double-row roller bearings. The truck brake equipment is the clasp type actuated by four 10-in. by 10 in. brake cylinders on each truck.

The locomotive is controlled by three main levers; the main throttle, the reverse lever and the brake handle. The movement of the main throttle controls the speed of the two Diesel engines through an electro-pneumatic device which actuates the speed governor on each engine. Local control stations, consisting of fuel- and lubricating-oil gages and engine speed indicator, permit the checking of engine operation at the engine. At the operator's station in the front cab is a hot-journal and wheel-slip indicator in addition to the customary speed indicator, air-brake and automatic-train-control gages.

Train heat is supplied by a Clarkson type steam generator working at 225 lb. pressure. The feedwater pumps, fire control and train-line pressure regulation is fully automatic and adjusted by a hand rheostat. Steam from this boiler heats the operator's cab and warms the engine water systems during lay-over or maintenance periods.



The cars are fitted with tight-lock couplers

Results and Conclusions of

Locomotive Slipping Tests*

By T. V. Buckwalter† and O. J. Horger††

IN all of the tests made the lifting of the driving wheels was confined entirely to the main pair of wheels and no lifting was observed on any of the other drivers. The suggested explanation for this action being limited to the main wheels at the speeds of testing is: (a) the actual overbalance in the main pair of wheels was always higher than on any other pair (Table III) and (b) the unsprung weight of the main pair of wheels is about 5,000 to 8,000 lb. greater than any other pair (Table IV). A discussion of the influence of these two factors is given later in this paper.

The location of the counterbalance in all these tests was found to be in the up position when the wheel was a maximum distance off the rail. The exact number of degrees that the counterbalance is off from the up vertical position has not yet been analyzed from the moving pictures. It is apparent from the pictures that once the wheels start lifting it is off the rail more than it is on the rail so that the counterbalance may be in almost any position, depending up the degree of lift.

Because of the see-sawing action of the pair of wheels across the rail as it vibrates up and down on the rail, the plane of the wheel is inclined to the rail instead of being vertical. This action may have some significance from the standpoint of what is happening in: (a) driving-wheel fits on axles; (b) stresses leading to failure of wheel centers; (c) axle stresses and failure in wheel fits; (d) misalignment of driving rods from their normal plane of operation, and (e) probable momentary transfer of tremendous forces on the other than main drivers in case of the application of sand.

It is generally confirmed that the engine crews are seldom aware that high-speed slipping is taking place in road service and neither in these slipping tests nor in road service has the crew known that rails were being kinked. In this respect the crews are becoming better acquainted with the handling of such power and wider use is being made of special devices to take care of these operating conditions.

The speed at which the driving wheel just begins to leave the rail is taken from pictures where the first evidence of an intermittent puff of smoke or fire is observed between the wheel and rail. This occurs when the counterbalance is in the down position adjoining the rail. This is an indication of a great change in wheel-rail pressure taking place and was the only means of determining just when the wheel started to leave the rail. Above this speed the wheel lifts off the rail an increasing amount as the speed increases and goes into violent vibration. It is in this latter speed range when rail damage may be produced although between these two speeds a number of marks of various degrees are produced on the rail.

4-6-4 Locomotive Tests

No rail damage sufficient to require replacement occurred in these tests with the exception of the first 4-6-4 locomotive tested, No. 3012, at a slipping speed of 108 m.p.h. Here 39 rails required replacement, the worst kink being 1/8 in. deep as measured over a length of 3 ft. In this test there were a total of 70 impressions on both rails which were produced when the wheel came down and struck the rail and of this total 53 were on the right and 17 on the left rail. These so-called rail impressions varied from 12 in. to 52 in. in length. The depth of these impressions varied from just being visible marks to actual kinks and the breaking of the scale on the web of the rail.

This same locomotive was also tested at one lower slipping speed of 98 m.p.h. and at this speed is was considered as having lifted slightly.

Locomotive No. 3001, which was essentially the same as No. 3012 with the exception that all drivers were equipped with roller bearings instead of plain bearings as on No. 3012 (both engines had heavy reciprocating parts and 315 lb. overbalance) was tested at slipping speeds of 88, 98 and 100 m.p.h. The performance at these speeds was comparable to the No. 3012. Tests on these two locomotives made it apparent that the application of roller bearings on the driving axles had no practical influence on the speed at which the wheels would leave the rail.

Locomotive No. 4003 was used in the third test and the important difference of this engine over Nos. 3012 and 3001 was that the total of the reciprocating weights was only 1,026 lb. as compared to 2,109 lb. In addition roller bearings were applied on all drivers including roller bearing crank pins and lightweight driving rods. Three slipping tests were made at 112, 123 and 128 m.p.h. and the main driving wheels lifted off the rail 3/4 in. at 128 m.p.h. and this compares with a lift of 7/8 in. on No. 3012 at 108 m.p.h. The important difference of this test of No. 4003 over No. 3012 was that no rail damage was done on any of these tests of No. 4003. At 112 m.p.h. there were indications that the wheel was just beginning to leave the rails and this compares with 88 m.p.h. found on Nos. 3012 and 3001, to indicate an increase of 27 per cent in speed.

Explanation as to why rail damage did not occur in this test may be found in the fact that on No. 4003 the wheel overbalance constituted a hammer having 103 lb. weight while the No. 3012 had 315 lb. The impact of this smaller hammer was not sufficient to cause rail damage.

4-8-4 Locomotive Tests

Two 4-8-4 locomotives with approximately the same overbalance, but differing in that No. 5623 had 44 per cent less weight of reciprocating parts than No. 5604, were tested. No. 5604, at slip speeds of 93 and 102 m.p.h., showed no wheel lift but at 104 m.p.h. it was believed to have lifted. At the time this locomotive was tested it was believed that the main overbalance was 310 lb., but since the test results did not develop as anticipated and in line with the other locomotives it was decided to weigh the overbalance after the completion of the test when it was found actually to be 125 lb. With

* Part II of the abstract of a paper presented before the New York Railroad Club, in connection with motion pictures, on February 17, 1939.

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†† In charge of railway engineering and research, Timken Roller Bearing Company, Canton, Ohio.

the large percentage of unbalanced reciprocating weights this locomotive proved to be a very bad rider at these test speeds and the general vibration of the entire locomotive was so severe that the focus of the camera lenses was disturbed during the test run. As a result, the pictures are slightly out of focus on all three tests which never happened on any of the other locomotives tested. Owing to this fact it is difficult to determine the intermittent puffs of smoke usually expected and the observations in Table II involve some doubt.

No. 5623, with lightweight reciprocating parts, was slipped at 111 and 115 m.p.h. without rail damage. Normal riding characteristics were observed at these speeds in comparison with the poor qualities of No. 5604 to the extent that No. 5604 could not be used at such speeds in road service. It is interesting to note that two of these six locomotives tested. The mathematical basis for these curves is given in the appendix of this paper showing that the vibration of the locomotive is treated as a system having a single degree of freedom for the simple case where springs are interposed between two masses which operate on a second set of springs. One of these masses is the sprung weight such as the boiler, frame etc.; the second mass is the unsprung weight of the driver axle assembly. These two masses are separated by driving springs and this unit is supported on the track structure which is considered here as an elastic foundation functioning as springs. This system has certain critical frequencies and if the driving wheels rotate near such critical speeds then forced vibrations will be produced by the overbalance. It is realized that these ideal assumptions are not fully realized in the case of actual

Table V — Comparison of Actual with Calculated Speeds at Which Main Driver Leaves Rail

Locomotive					Speed at which main driver just leaves the rail, m.p.h.			
					Calculated values			
Class	Number	Reciprocating weight per side, lb.	Overbalance lb.	Train speed entering greased section	Due to vibrations track modulus 1,500 lb. per in., per in.	Due to inertia effects of overbalance	Slip speeds at which locos. were tested and observations as to main wheel lift off rail	Rail damage requiring replacement
4-6-4	3012	2,109	315	56	86	99	98—Lifted slightly	None
				66			108—Lifted ⅞ in.	39 rails
4-6-4	3001	2,109	315	47			88—Intermittent puff smoke Believed just lifting	None
				67	86	100	98—Lifted slightly	None
				70			100—Lifted slightly	None
4-6-4	4003	1,026	103	72			112—Intermittent puff smoke Believed just lifting	None
				78	114	158	123—Lifted slightly	None
				81			128—Lifted ¾ in.	None
4-8-4	5604	2,480	125	67			93*—No smoke or lift visible	None
				74	94	120	102—No smoke or lift visible	None
				80			*104—Smoke visible—Believe lifted slightly	None
4-8-4	5,623	1,378	115	78	..	...	111—Lifted slightly	None
				80	97	127	115—Lifted about ½ in.	None
2-10-4	6314	2,453	175	51	..	...	80—Lifted slightly	None
				53	79	96	80—Lifted slightly	None

* Camera lens focus changed during test run and pictures were slightly out of focus due to severe locomotive vibrations explained in text.

locomotives save approximately $503 per day in operating expense by doubling the North Coast Limited and the Empire Builder between Aurora, Ill. and St. Paul, Minn., a distance of 402 miles, when normal train heating conditions permit. This engine satisfactorily makes the schedule with trains as heavy as 23 passenger-train cars. It is an outstanding performance and illustrates in marked fashion the wide field of usefulness for heavy eight-coupled locomotives equipped with proper balance and light-weight reciprocating parts thus permitting their operation at passenger-train speeds.

2-10-4 Locomotive Tests

The 2-10-4 locomotive tested is a heavy freight engine designed originally for hauling coal over the Beardstown Division from Southern Illinois to the Chicago district. Two slip tests were made at 80 m.p.h. which showed the wheel lifting slightly.

The motion pictures show relatively smooth operation of this large locomotive at the slipping speed of 80 m.p.h. and illustrates the wide value of usefulness for this heavy type of locomotive when equipped with the speed-raising factors of lightweight parts in connection with stabilized lateral motion following the use of roller bearings.

Effect of Overbalance on Wheel Lifting

An anlysis was made of the influence of the various factors which would cause forced vibrations of the driving wheel on the rail. Such calculations may enable one to predict the critical wheel speed as well as to give a rational explanation of the test results. Figs. 3, 13, and 19, and Table V show curves made in this study for the locomotive operating conditions, but until further data are available this method of analysis presents some very interesting facts which will now be discussed.

The speed at which the main driving wheel should leave the rail for various modulii of track structure is shown in Fig. 3* for all three 4-6-4 locomotives tested. The lower full line curve shows the wheel for Nos. 3012 and 3001 having 315 lb. overbalance as lifting at 86 to 90 m.p.h. for a track modulus varying from 1,500 to 3,000 lb. per in. per in. If the track was considered very rigid so that no vibration phenomenon were present then the inertia effect of overbalance would cause the wheel to leave at 99 m.p.h. as indicated in Fig. 3. Similar comments may be made of the upper full line curve for No. 4003 where the wheel is shown leaving the rail at 114 to 128 m.p.h., while if the inertia force of the overbalance was considered as a criterion, then the wheel would not leave until 158 m.p.h. The upper dotted curve predicts the condition for zero overbalance which was not tested.

A comparison of these calculated speeds at which the wheel leaves the rail is shown in Table V with the observed values from test.

Several general deductions which may be observed from this study are:

(a) When the overbalance is large, such as 315 lb., then the stiffness of the track has very little influence on the speed at which the driving wheel leaves the rail.

(b) As the overbalance approaches zero the value of the stiffness of the track becomes more important but such high allowable speeds are not of immediate interest.

* Figs. 3 to 8 inclusive appear on page 88 of the March issue.

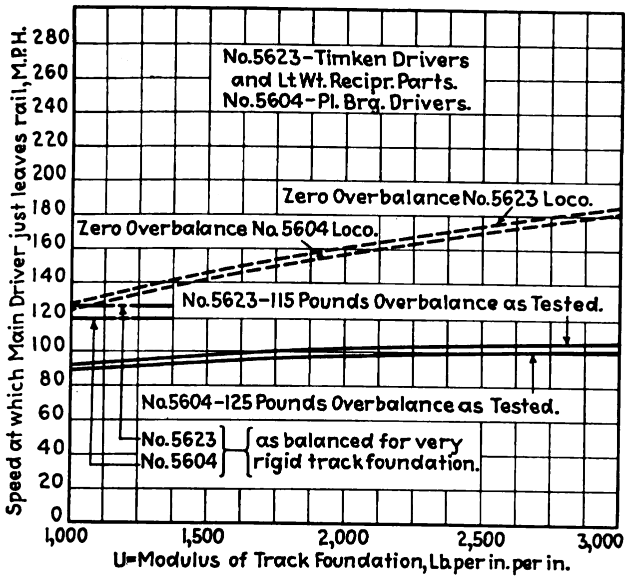


Fig. 13—Comparison of calculated speeds at which main drivers just leave rail—4-8-4 type locomotives

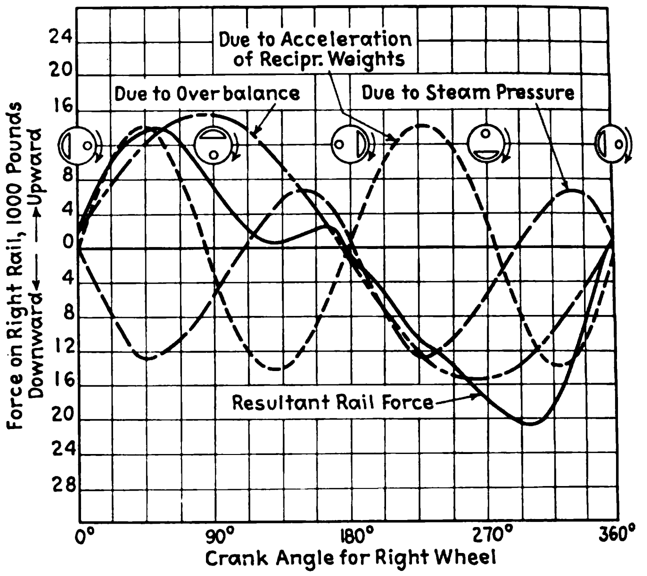


Fig. 16—Dynamic rail force under main driver; locomotive No. 5623 (Timken drivers and light weight reciprocating parts) at 90 m. p.h.

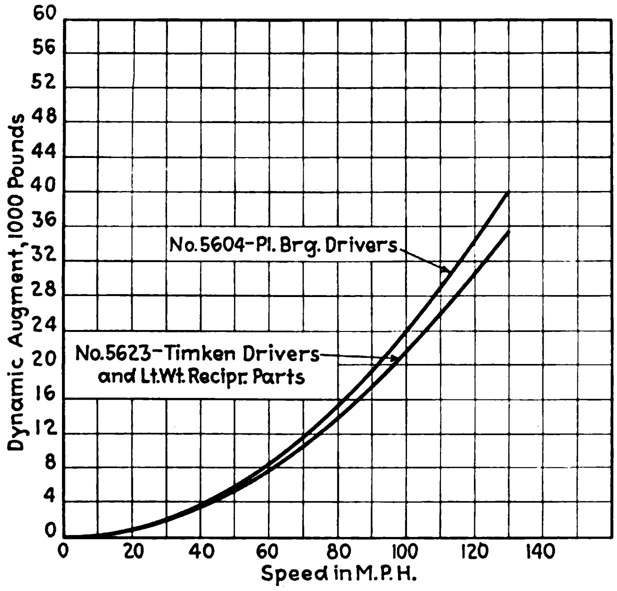


Fig. 14—Comparison of dynamic augment for main drivers—4-8-4 type locomotives

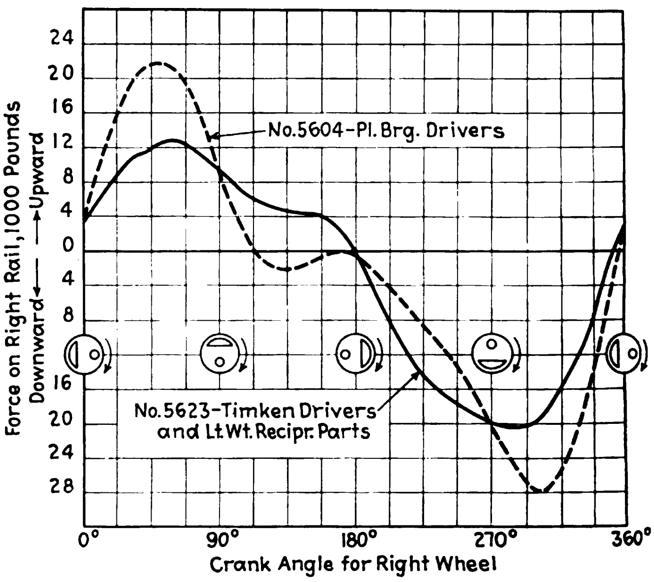


Fig. 17—Comparison of resultant dynamic rail force for 4-8-4 type locomotives at 90 m. p.h.

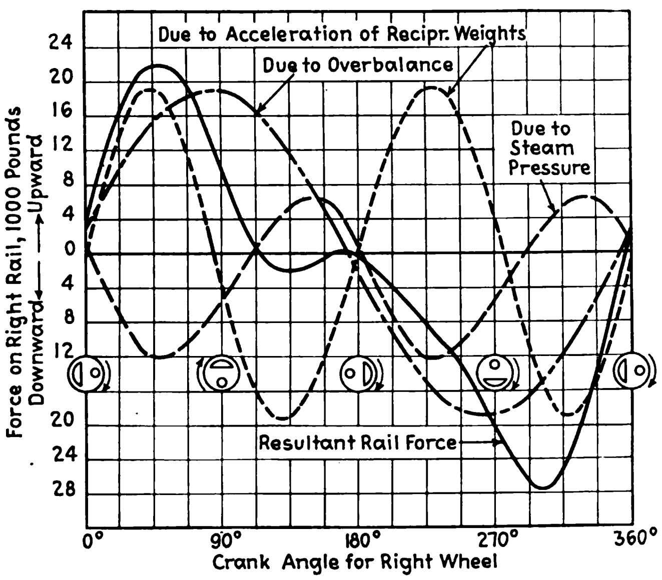


Fig. 15—Dynamic rail force under main driver; locomotive No. 5604 (plain bearings) at 90 m. p.h.

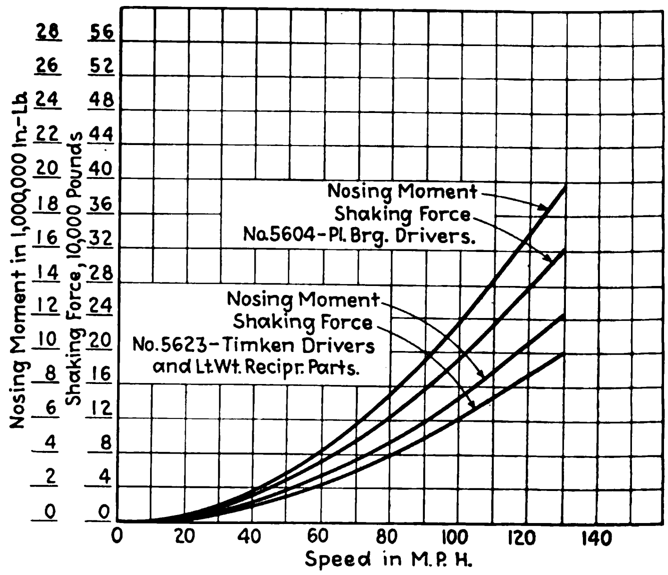


Fig. 18—Comparison of turning moment and fore-and-aft shaking force; 4-8-4 type locomotives

(c) Vibration phenomenon in many cases causes the wheel to lift off the rail within present locomotive operating conditions and at a speed much less than that required for the inertia force of the overbalance to be equal to the wheel load.

(d) Reduction of overbalance is a more important factor than increased track stiffness to permit higher operating speeds—this does not mean that heavier track is not desirable in order to reduce track stresses.

(e) A decrease of 1,000 lb. in the unsprung weight of the driving axle with 200 to 300 lb. overbalance would increase the speed at which the wheel leaves the rail by about 3 to 4 m.p.h.—this is not shown by these curves but may be determined using the calculations given in the appendix.

(f) More fundamental test data are necessary for the general application of vibration theory in practice, but indicated procedure gives results in good agreement with test values as shown in the table.

Main-Rod Error in Counterbalance Calculations

It is now customary in counterbalance calculations to consider the scale-pan weight of the back end of the main rod as rotating and the front-end weight as a portion of the total reciprocating weights. This procedure has existed for many years, although Henderson, in 1907, in his book, "Locomotive Operation," page 57, recognized that the proper division of back- and front-end weight requires a determination of the radius of gyration. He suggested that the radius of oscillation be found experimentally by swinging the rod as a pendulum. His practical conclusions for main-rod designs prevailing at that time were "one-half of the weight of the main rod is not far wrong for an approximation as to the balance needed to be added to the main wheel, considered as acting at the crank-pin radius."

This discrepancy between the existing procedure and the recommendations of Henderson introduces considerable error in the counterbalance statement of locomotives. Unfortunately, this error is in the wrong direction in that the overbalance in the counterbalance plane is actually higher than that given by the usual counterbalance statement. The actual error in the plane of counterbalance for the back end of the main rod and the corresponding increase in dynamic augment at diameter speed above the usually calculated value for the respective cross-counterbalanced engines is:

Locomotive	Main-rod error, lb.	Increased dynamic augment, lb.
3001-3012	107	4,800
4003	78	3,500
5604	131	5,100
5623	112	4,300

The above statements are based on pendulum tests of the main rods on the 4-6-4 and 4-8-4 locomotives used in these slipping tests. Here is was found that seven-eighths of the scale-pan weight of the back end of the plain-bearing main rod should be considered as rotating weight, and on roller-bearing rods a ratio of 0.82 was ascertained. For this reason, the counterbalance record in Table III gives the usual statement of balance along with the corrected values. These corrected values are the basis of all calculations in this paper unless specified, although, where reference is made to overbalance in either the text or in curves, the conventional overbalance value is stated.

Static balancing of the main driving axles is still being used on many locomotives, and the mechanical officers of some railroads are firm in their convictions that such a method has resulted in satisfactory operation of their locomotives. Some justification for their contentions may be attributed to the above-mentioned error in the distribution of main-rod weight. In the case where wheels are statically balanced, the compensation for this error tends to bring the static balance to an actual value which is somewhere between the static and cross-balanced wheels and may result in a favorable balance from the standpoint of dynamic augment and speed at which the wheels will leave the rail.

Vertical Rail Forces Under the Main Wheel

Dynamic augment due to overbalance is the usual variable force calculated as acting on the rail, but there are two additional rail forces which are present and sometimes of considerable importance, but very seldom, if ever, considered. These two forces are a function of the angularity of the main rod and produced by (a) piston-thrust values from the indicator card, and (b) the inertia of reciprocating parts. It is the combination of these two forces with that of the dynamic augment which are calculated here for the six locomotives tested and may be considered as the three principal factors constituting a resultant variable force on the rail. This resultant must be added to the static wheel load, plus any forces due to locomotive oscillation, vibration (impact factor), etc., and does not take care of additional forces due to irregular track, out-of-round wheels, etc., or the correction for wheel arrangement and spacing.

These calculated forces are shown for all three 4-6-4 locomotives in curves of Figs. 4, 5, 6, and 7. Maximum dynamic augment due to overbalance for various locomotive speeds is shown in Fig. 4, while Figs. 5 and 6 indicate how the three forces and their resultant varies during one revolution of the driving wheel. Fig. 7 compares the resultant rail forces shown in Figs. 5 and 6 for the cases of locomotives No. 3012 and 3001 having conventional weight of reciprocating parts and overbalance with No. 4003 which has light-weight reciprocating parts and low overbalance. The effect of the unbalanced reciprocating weight in producing shaking forces in the fore and aft directions as well as nosing or turning moment of the locomotive on the rails is shown in Fig. 17. In this the influence of tractive force at the wheels is neglected.

Similar studies are also shown for 4-8-4 locomotives in Figs. 14 to 18, inclusive and for 2-10-4 type in Figs. 20 to 24, inclusive.

Commenting on all these curves, it should be noted that as a result of about 50 per cent reduction in reciprocating weight and lower overbalance a much more favorable condition on track and locomotive is obtained as follows:

(a) Reduction of 60 per cent in dynamic augment is obtained on the 4-6-4 (Fig. 4) and 75 per cent on the 2-10-4 locomotives (Fig. 20).

(b) Even though the overbalance is decreased, the unbalanced forces producing shaking and nosing moment are at the same time decreased about 40 per cent for the 4-6-4 (Fig. 8) and about 25 per cent for the 2-10-4 locomotives (Fig. 24). Decreasing the overbalance in itself without reciprocating weight will increase the unbalanced disturbing forces shown in Figs. 8 and 24. There is a limit to which the unbalanced forces on conventional engines may be increased to give good riding qualities of a locomotive and minimum cost of track and locomotive maintenance, all of which are unknown factors from a standpoint of dollar value.

(c) Resultant variable rail force for 4-6-4 locomotives (Fig. 7) shows a favorable reduction of about 55 per cent in the downward, and 75 per cent in the upward directions to give a 65 per cent less overall change in variable rail force.

(d) Resultant variable rail force for the 2-10-4 locomotives (Fig. 23) shows a favorable overall reduction of about 68 per cent. This modified M-4-A was not tested, but is under construction, and it will be interesting to observe its service performance in view of its being underbalanced as calculated by conventional methods.

(e) With about the same overbalance on the two 4-8-4 locomotives the dynamic augment (Fig. 14) is about the same, but, due to the 44 per cent lower weight of reciprocating parts of No. 5623 compared with No. 5604, the resultant rail force (Fig. 17) is about 25 per cent less in the downward, and 40 per cent less in the upward, direction to give about 30 per cent less overall change in variable rail force.

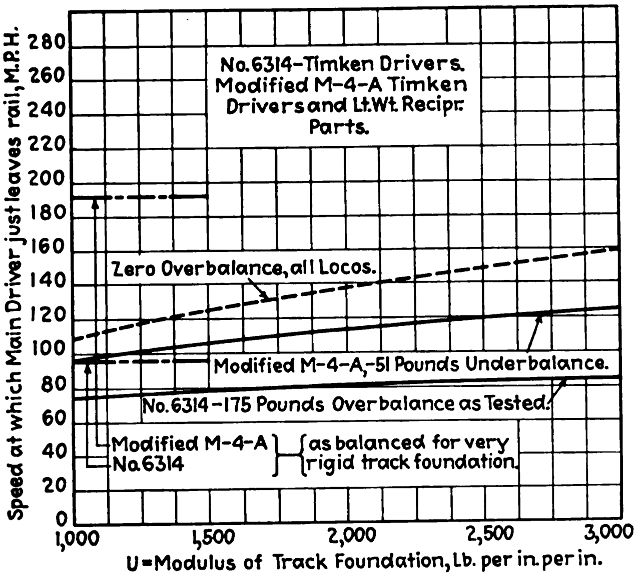


Fig. 19—Comparison of calculated speeds at which main drivers just leave the rail; 2-10-4 type locomotives

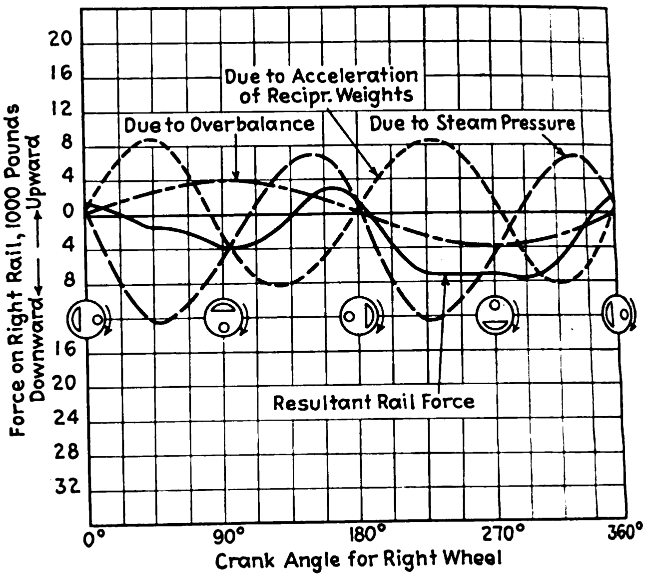


Fig. 22—Dynamic rail force under main driver; modified class M-4-a, 2-10-4 type locomotive equipped with Timken driver bearings and light-weight reciprocating parts

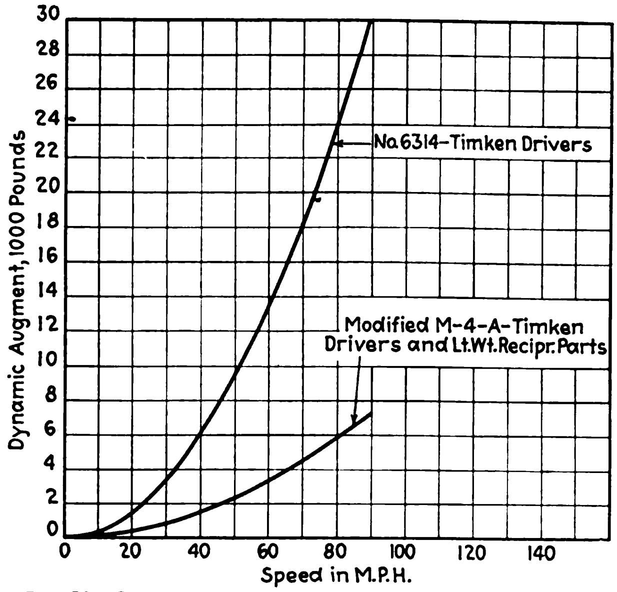


Fig. 20—Comparison of dynamic augment for main drivers; 2-10-4 type locomotives

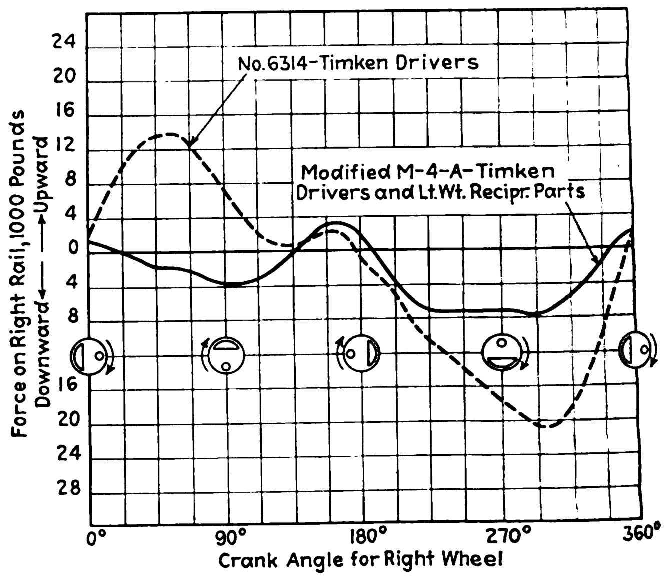


Fig. 23—Comparison of resultant dynamic rail force for 2-10-4 type locomotives at 64 m. p.h.

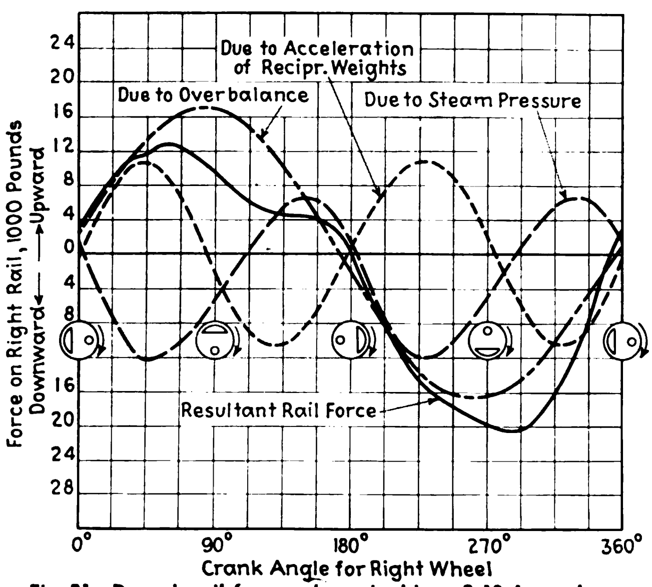


Fig. 21—Dynamic rail force under main driver; 2-10-4 type locomotive No. 6314, equipped with Timken driver bearings

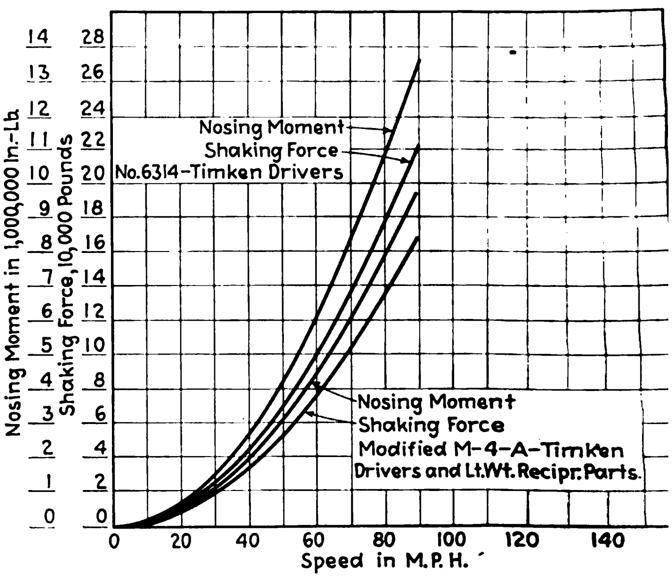


Fig. 24—Comparison of turning moment and fore-and-aft shaking force; 2-10-4 type locomotives

(f) Of the two 4-8-4 locomotives having about the same overbalance, No. 5623, with 44 per cent lower reciprocating weight than No. 5604, gives about 35 per cent less disturbing force (Fig. 18) and should be a much better riding engine as was found on the test.

(g) The frequency of the rail force components due both to piston thrust and inertia of reciprocating parts is twice that of the dynamic augment, as indicated in Figs. 5, 6, 15, 16, 21, and 22. For this reason their effect (neglecting that they do not vary according to a sine law) in causing vibrations at the test speeds is of much less importance than the dynamic augment.

(h) Large variations in wheel pressure and the large magnitude of the shaking forces and nosing moments given in all these curves may be suggested as being partially responsible for intermittent slipping of drivers to the extent that it affects the frictional coefficient between the wheel and rail.

It is appreciated that the above analysis is based on calculations, although only fundamental principles of mechanics are applied. The procedure used requires much additional study in correlation with further locomotive and track tests.

Permissible Locomotive Operating Speeds

Following these tests it was necessary to establish maximum safe operating road speeds from the standpoint of rail damage for locomotives of the classes tested. Such speed was determined from a study of: (a) The slipping test speed at which the main driving wheels started to leave the rail; (b) speed for which the dynamic augment was equal to 50 per cent of the static wheel load, and (c) speed at which the calculated rail stress would be about 30,000 lb. per sq. in. It was considered that a compromise maximum speed for locomotive operation

Table VI — Permissible Maximum Locomotive Road Speeds

Locomotives	Weight, lb. Reciprocating parts	Weight, lb. Overbalance main wheel	Max. road speed, m.p.h.
4-6-4 (like nos. 3012 and 3001)	2,109	315	75
4-6-4 (like No. 4003)	1,026	103	No limit
4-8-4 (like No. 5604 but with conventional overbalance)	2,480	310	75
4-8-4 (like No. 5623)	1,378	115	No limit
2-10-4 (like No. 6314)	2,453	175	60

could be selected from these three criteria which would not cause rail damage. On this basis, the maximum road speeds were specified as in Table VI which indicates the increase in allowable speed permitted on those locomotives equipped with light-weight reciprocating parts over those having conventional weights. In order to make

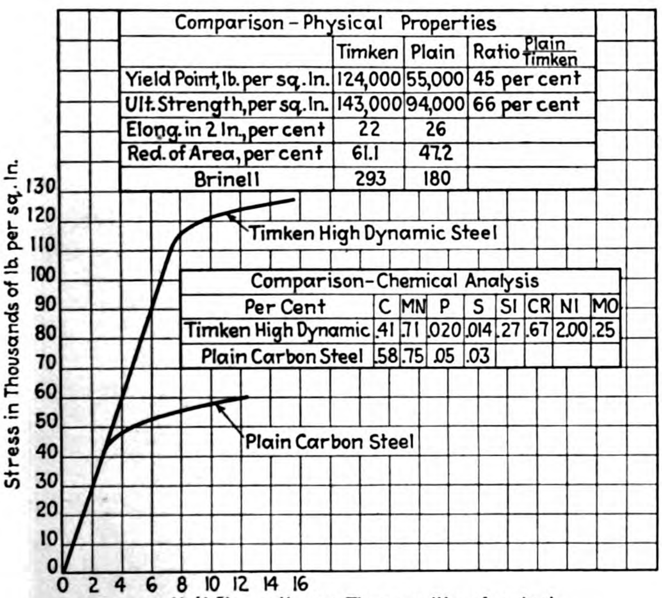


Fig. 25—Comparison of stress-strain diagrams for Timken High-Dynamic and plain carbon steels

train schedules, however, it is necessary to exceed the speed values given in Table VI by about 5 m.p.h.

Method of Obtaining Light Reciprocating and Rotating Weights

The material used in these parts has the trade name of Timken high dynamic steel and the chemical analysis and physical properties are given in Fig. 25 in comparison with plain carbon steel commonly used. All parts are steel, except for the use of an aluminum crosshead shoe, and detail weights of the respective parts are shown in Table II in comparison with parts of conventional design and material.

All parts are heat treated and are either die forged, rolled, or steel tubing, with the exception of crank pins which are hammer forgings. Particular emphasis is placed on proper grain flow for maximum strength. In addition to using a material having over twice the static strength of the usual steel used for this purpose, important consideration is given to the shape of the various design members so as to give the proper distribution of metal for maximum strength with minimum weight.

Further data on this subject are published in the Transactions of the American Society of Mechanical Engineers, April, 1937, page 225*.

Future Locomotive Design

General conclusions from this paper indicate that many new problems are associated with high-speed locomotives. It is believed that the application of light-weight parts both to the reciprocating and rotating parts will be an essential modification required on high-speed steam loco-

Fig. 26—A rail kink 1/8 in. deep produced by locomotive No. 3012 at 108 m. p. h. slipping speed

motives for satisfactory operation of not only the locomotive, but also the effect such operation will have on existing and even greatly improved track and bridge structures.

While it is not difficult to obtain agreement that such weight reductions are desirable, there may be some questions as to whether satisfactory designs are available, and operating performance records indicate the advisability of making such departures from conventional practice. The answer to these questions may be found from the record of 64 locomotives which are in operation over several railroads in the heaviest and fastest passenger and freight service where the total accumulated service is 9,000,000 miles. All of these locomotives have light-weight reciprocating parts and 14 have, in addition, light-weight rods and roller-bearing crank pins. These 14 en-

* For an abstract of this paper see *Railway Mechanical Engineer*, August, 1937, page 348.

gines have a total accumulated service of 1,700,000 miles. New applications being built or just placed in service also total 14 locomotives.

The usual price of pioneering has been experienced in this field of lightweight parts in that failures have occurred. This development generally has been extremely encouraging, and in this respect much credit is due those railroads which have contributed toward its success.

Appendix

Formula for Determining the Speed At Which Driving Wheels Just Lift Off the Rail Due to Vibrations

The equation used to calculate the minimum locomotive speed, in miles per hour, at which a driving wheel of a steam locomotive lifts off the rail due to vibrations caused by overbalance (or underbalance) is:

$$\text{M.p.h.} = \frac{\omega D}{35.2} = \frac{D}{35.2}\sqrt{\frac{(K + K_{rail})\,g}{W + \left(\frac{K_{rail}}{S + W}\right) RW_{over}}}$$

Where:

- m.p.h. = lowest speed at which wheel leaves rail, m.p.h.
- ω = angular velocity of driving wheel, radians per second
- D = diameter of driving wheels, in.
- g = acceleration of gravity = 384 in. per second per second
- R = Crank radius, in.
- K = spring stiffness of spring between driving-axle housing and frame per side, lb. per in.
- K_{rail} = Rail stiffness = force required to depress rail a distance of one inch, lb. per in.
- S = Sprung weight per driver, lb.
- W_{over} = overbalance at crank radius per driver, lb.
- W = unsprung weight per driver, lb.

The derivation of the above equation is given below. In this derivation, vibrations of the body of the locomotive, the effects of friction, the effects of inertia forces on the reciprocating parts combined with angularity of the main rod, the effects of piston thrust due to steam pressure combined with angularity of the main rod, the effect of rail deflection due to one driver on vibrations of the other drivers, the effect of the mass of the rail, the effect of the spring equalizer system, and other effects are neglected. It is believed that all these effects are secondary compared to the effect of overbalance when the overbalance is considered as is the case on most steam locomotives.

With the above simplifications, the disturbing force on a driving wheel tending to set up vertical vibrations of the driver on the rail is:

$$F = \frac{W_{over}}{g}\,\omega^2 R \cos\omega t$$

this being the upward component of the centrifugal force on the equivalent overbalance in the wheel at crank radius, with

t = time in seconds which has elapsed since the crank was at its extreme downward position (the overbalance is assumed to be directly opposite the crank).

The upward displacement of the driving wheel from its normal position due to the above disturbing force will be (Vibration Problems in Engineering, by S. Timoshenko, page 9, equation 19):

$$X = \frac{F}{(K + K_{rail})} \times \frac{1}{\left(1 - \frac{\omega^2}{p^2}\right)} = \frac{RW_{over}}{W} \times \frac{\omega^2}{p^2 - \omega^2} \cos\omega t$$

Where

$$p^2 = \frac{(K + K_{rail})\,g}{W}$$

and the maximum value of X will be

$$X_{max} = \frac{RW_{over}}{W} \times \frac{\omega^2}{p^2 - \omega^2}$$

If the wheel is on the point of leaving the rail, then

$$X_{max} = \frac{S + \omega}{K_{rail}}$$

this being the deflection of the rail due to the static wheel load. Then the minimum speed at which the wheel will leave the rail is obtained by solving the equation:

$$\frac{S + W}{K_{rail}} = \frac{RW_{over}}{W} \times \frac{\omega^2}{p^2 - \omega^2}$$

which gives

$$\omega = \frac{p}{\sqrt{1 + \left(\frac{K_{rail}}{S + W}\right)\frac{W_{over}}{W} R}} = \sqrt{\frac{(K - K_{rail})\,g}{W + \left(\frac{K_{rail}}{S + W}\right) RW_{over}}}$$

and since

$$\text{M.p.h.} = \frac{\omega D}{35.2}$$

we get

$$\text{M.p.h.} = \frac{D}{35.2}\sqrt{\frac{(K + K_{rail})\,g}{W + \left(\frac{K_{rail}}{S + W}\right) RW_{over}}}$$

Fig. 27—Worn spot on right rail at tie marker No. 55; produced by locomotive No. 3012 at 108 m. p. h. slipping speed

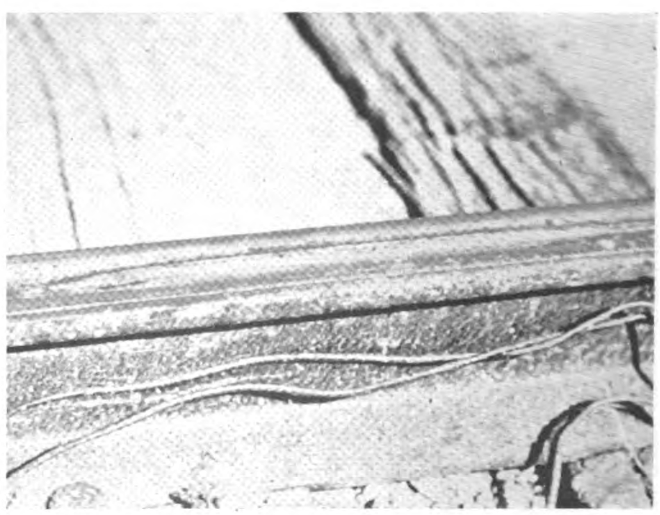


Fig. 28—Worn spot on rail three feet before tie marker No. 50; also produced by locomotive No. 3012 at slipping speed of 108 m. p. h.

Passenger Cars Air-Conditioned During 1938

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generators: No.	Generators: Capacity Kw.	Generators: Type of Drive	Generators: Type of Mounting	Storage Batteries: Make	Storage Batteries: Amp.-Hr. Capacity	Outside Power Supply
A. T. & S. F.	32	Chair	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	Exide	850	....
	12	Diners	St. ejec.	Safety C. H. & L.	....	Water	2	{1-2 1-4}	Flat belt	Truck	Exide	850	....
							10	10	Flat belt	Body	Exide	850	....
A. C. L.	25	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	{19 Exide 6 Edison}	850	....
Can. National	65	Coaches	Ice	Sturtevant	....	Ice	1	4	{Flat belt in summer—chain in winter}	Truck	Exide, Edison or Gould	600	....
	20	Diners	Ice	Sturtevant	....	Ice	{8 12	5} 4}	Flat belt or chain	Truck	Exide and Gould	600	....
	2	Chair	Ice	Sturtevant	....	Ice	1	5	Flat belt	Body	Gould	600	....
	57	Sleepers	Ice	Sturtevant	....	Ice	1	4	Flat belt	Truck	Exide and Gould	600	....
Can. Pacific	42	Coaches	Ice	Sturtevant	....	Ice	{19 23	5} 3}	Gear	Body	{3 Exide 2 Gould 23 Edison 14 Edison 12 Edison 4 Gould	600 600 300 595 595 600	....
	16	Diners	Ice	Sturtevant	....	Ice	1	3	Belt	Body			
	2	Buffet-lounge	Ice	Sturtevant	....	Ice	1	5	Gear	Body	Exide	600	....
	1	Cafe-chair	Ice	Sturtevant	....	Ice	1	3	Gear	Body	Gould	600	....
	4	Buffet-chair	Ice	Safety C. H. & L.	....	Ice	1	3	Gear	Body	Edison	595	....
	17	Sleepers	Ice	Safety C. H. & L.	....	Ice	1	3	Belt	Body	Edison	595	....
	2	Sleepers	Ice	Sturtevant	....	Ice	1	5	Gear	Body	Exide	600	....
	1	Sleeper	Ice	Airtemp	....	Ice	1	5	Gear	Body	Exide	600	....
	4	Sleepers	Ice	Safety C. H. & L.	....	Ice	1	5	Gear	Body	Exide	600	....
	1	Lounge	Ice	Safety C. H. & L.	....	Ice	1	7½	Gear	Body	Gould	600	....
Central of Georgia	8	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	{10 Edison	850	....
	3	Comb.	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	1 Exide	680	....
C. & E. I.	2	Comb.	St. ejec.	Safety C. H. & L.	....	Water	1	2½	Flat belt	Body	Gould	850	....
	1	Coach	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt-gear	Body	Philco	940	....
C. M. St. P. & P.	4	Comb.	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt	Truck	Gould	850	....
	24	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt	Truck	{7 Gould 17 Exide	850 823	....
	5	Coaches	Mech.	Waukesha	Gas engine	Freon	1	5	V-belt	Truck	Gould	450	....
	4	Diners	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt	Truck	Gould	850	....
	10	Chair	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt	Truck	Exide	833	....
	2	Cafe-chair	Mech.	Waukesha	Gas engine	Freon	1	5	V-belt	Truck	•Exide and Gould	450	....
C. R. I. & P.	10	Coaches	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	......	400	....
	1	Diner	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	......	400	....
	1	Business	Ice	A. C. F.	....	Ice	1	4	Flat belt	Body	......	400	....
D. L. & W.	1	Business	Ice	Safety C. H. & L.	....	Ice	2	4	V-belt	Body	Edison	850	....
	1	Business	Ice	Safety C. H. & L.	....	Ice	1	5	V-belt	Body	Gould	600	....
Great Northern	6	Coaches	Ice	P. S. C. M. C.	....	Ice	1	4	{4 Flat belt 2 V-belt}	Body	Exide	600	....
	1	Coach	Ice	R. R. Co.	....	Ice	1	4	V-belt	Body	Exide	500	....
	2	Cafe-chair	Ice	R. R. Co.	....	Ice	1	4	V-belt	Body	Exide	500	....
	1	Business	Ice	R. R. Co.	....	Ice	1	7½	V-belt	Body	Exide	888	....
Lehigh Valley	1	Lounge diner	Electro-mech.	General Electric Co.	Motor	Freon	1	20	V-belt-gear	Body	Exide	1,000	....
M. St. P. & S. Ste. M.	2	Cafe-sleepers	Ice	P. S. C. M. C.	....	Ice	1	3	Flat belt	Body	Gould	600	....
M.-K.-T.	20	Chair	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt-gear	Body	{10 Gould 10 USL}	1,000	....
Mobile & Ohio	2	Lounge-diners	Mech.	Wuakesha-Trane	Gas engine	Freon	1	5	Flat belt	Body	Exide	450	....
N. Y. C. System	2	Coaches	Electro-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Exide }	600 at	*
	6	Diners	Electro-mech.	Frigidaire	Motor	Freon	1	20	Gear	Truck	Exide }	64 v.	*
N. Y. N. H. & H.	50	Coaches	Electro-mech.	Frigidaire-Safety C. H. & L.	Motor	Freon	1	20	Gear	Body	Exide	500	*
Norfolk & Western	5	Coaches	Electro-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Edison	300 at 110 v.	*
Northern Pacific	4	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Gould	600	*
	5	Coaches	Mech.	Waukesha-Trane	Gas engine	Freon	1	5	V-belt	Body	Exide	500	....
	2	Cafe	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Gould	600	*
	1	Chair	Mech.	Waukesha-Trane	Gas engine	Freon	1	4	V-belt	Body	Exide	600	....
Pennsylvania	2	Coaches	Mech	Airtemp	Gear	Freon	1	10	Gear	Body	......	1,250	....
	2	Diners	Electro-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	......	1,250	....
	1	Diner	Electro-mech.	Frigidaire	Motor	Freon	1	7.6	V belt	Body	......	1,000	....

*Cars marked thus are equipped for 220-volt a.c. operation at terminals

Passenger Cars Air-Conditioned During 1938 (Continued)

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generator No.	Generator Capacity Kw.	Generator Type of Drive	Generator Type of Mounting	Storage Batteries Make	Storage Batteries Amp.-Hr. Capacity	Outside Power Supply
Pullman Co.	45	Sleepers	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	550	•
	1	Sleeper	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	7½	V-belt-gear	Body	Exide	550	•
	1	Sleeper	Electro-mech.	P. S. C. M. C.	Motor	Freon	1 1	15 4	V-belt-gear Flat belt	Body	Exide	1,000	•
	4	Sleeper	Ice	Pullman	....	Ice	1	4	Flat belt	Body	Exide	600	....
	8	Chair	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	550	•
	60	Sleepers	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	5	V-belt	Body	Exide	620	•
	37	Sleepers	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	7½	V-belt-gear	Body	Exide	875	•
	11	Sleeper-obs.	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	10	V-belt-gear	Body	Exide	875	•
	15	Sleeper-lounge	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	10	V-belt-gear	Body	Exide	875	•
	27	Sleepers	St. ejec.	Safety C. H. & L.	....	Water	2	5	V-belt	Body	Exide	875	....
	7	Sleeper-obs.	St. ejec.	Safety C. H. & L.	....	Water	2	5	V-belt	Body	Exide	875	....
St. L.-S. F	2	Coaches	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	Exide	504	....
	6	Comb.	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	Exide	504	....
	4	Chair	Mech.	Waukesha	Gas engine	Freon	1	4	2 Flat belt 2 V-belt	Body	Exide	504	....
Seaboard A. L.	4	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Edison	300	....
Southern	79	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	Exide	600	....
	27	Comb.	St. ejec	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	Exide	600	....
Un. Pac.	2	Lounge-diners	Mech.	Waukesha	Gas engine	Freon	1	5	Flat belt	Body	Exide	500	....
	1	Business	Mech.	Waukesha	Gas engine	Freon	1	5	Flat belt	Body	Exide	1,000	....

Summary of Cars Air-Conditioned During 1938

Railroad	Number of Cars	Type of Car: Coach	Combination	Dining (Note A)	Chair (Note B)	Observation	Sleeping (Note C)	Business	Type of System: Electro-Mech.	Direct Mech.	Ice	Steam Ejector	Refrigerant Used: Freon	Water	Ice
A. T. & S. F.	44	...	...	12	32	...	...	...	...	...	...	44	...	44	...
A. C. L.	25	25	...	...	...	...	...	...	...	...	...	25	...	25	...
Can. National	144	65	...	20	2	...	57	...	...	...	144	...	...	...	144
Can. Pacific	90	42	...	23	1	...	24	...	...	...	90	...	...	...	90
Central of Georgia	11	8	3	...	...	...	...	...	...	...	...	11	...	11	...
C. & E. I.	3	1	2	...	...	...	...	...	...	...	...	3	...	3	...
C. M. St. P. & P.	49	29	4	6	10	...	...	...	...	7	...	42	7	42	...
C. R. I. & P.	12	10	...	1	...	...	...	1	...	11	1	...	11	...	1
D. L. & W.	2	...	...	...	...	...	...	2	...	...	2	...	...	...	2
Great Northern	10	7	...	2	...	...	...	1	...	...	10	...	...	...	10
Lehigh Valley	1	...	...	1	...	...	...	...	1	...	...	...	1	...	...
M. St. P. & S. Ste. M.	2	...	...	...	...	...	2	...	...	...	2	...	...	...	2
M-K.-T.	20	...	...	...	20	...	...	...	...	...	...	20	...	20	...
Mobile & Ohio	2	...	...	2	...	...	...	...	...	2	...	...	2	...	...
N. Y. C. System	8	2	...	6	...	...	...	...	8	...	...	...	8	...	...
N. Y. N. H. & H.	50	50	...	...	...	...	...	...	50	...	...	...	50	...	...
Norfolk & Western	5	5	...	...	...	...	...	...	5	...	...	...	5	...	...
Northern Pacific	12	9	...	2	1	...	...	...	...	12	...	...	12	...	...
Pennsylvania	5	2	...	3	...	...	...	...	3	2	...	...	5	...	...
Pullman Co.	216	...	...	...	8	...	208	...	1	177	4	34	178	34	4
St. L.-S. F.	12	2	6	...	4	...	...	...	...	12	...	...	12	...	...
Seaboard A. L.	4	4	...	...	...	...	...	...	...	4	...	...	4	...	...
Southern	106	79	27	...	...	...	...	...	...	...	...	106	...	106	...
Union Pacific	3	...	...	2	...	...	...	1	...	3	...	...	3	...	...
	836	340	42	80	78	...	291	5	68	230	253	285	298	285	253

Note A—Includes lounge-diners, coach-diners, cafe chair, cafe coach, kitchen coach and buffet cars.
Note B—Includes lounge-chair, coach-chair and observation-chair cars.
Note C—Includes lounge- and observation-sleepers.

Nine-Year Summary of Air-Conditioned Cars

Railroad	Total Cars Dec. 31, 1937	Total Cars Dec. 31, 1938	Type of Car: Coaches	Comb.	Dining (Note 1)	Chair (Note 2)	Observation	Sleeping (Note 3)	Business	Type of System: Electro-Mech.	Direct Mech.	Ice	Steam Ejector	Type of Refrigerant: Freon	Water	Ice
Alton	25	25	4	4	9	6	2	...	...	25	...	...	...	25	...	...
A. T. & S. F.	262	306	26	6	77	174	18	5	...	1	...	...	305	1	305	...
A. C. L.	109	134	106	...	28	...	...	...	...	11	...	...	123	11	123	...
B. & O.	372	372	225	55	75	6	10	...	1	372	...	...	...	372	...	...
B. & M.	90	90	82	4	4	...	...	...	...	30	...	60	...	30	...	60
Can. National	253	397	125	...	76	18	...	178	...	...	...	397	...	...	...	397
Can. Pacific	305	395	50	4	79	15	6	236	5	...	...	395	...	...	...	395
Central of Georgia	44	55	46	6	2	...	...	...	1	...	...	1	54	...	54	1
C. R. R. of N. J.	23	23	17	2	4	...	...	...	...	23	...	...	...	23	...	...
C. & O. (Incl. P. M.)	113	113	79	14	12	...	...	...	8	...	104	...	9	104	9	...
C. & E. I.	31	34	22	5	7	...	...	...	...	...	2	5	27	2	27	5
C. & N. W.	196	196	115	16	37	28	...	...	...	12	110	74	...	122	...	74
C. B. & Q.	151	151	84	8	36	4	5	14	...	113	4	34	...	117	...	34
C. M. St. P. & P.	247	296	142	9	55	27	4	57	2	...	21	275	...	21	275	...
C. R. I. & P.	150	162	69	4	38	46	4	...	1	18	26	106	12	44	12	106
D. & H.	6	6	...	...	6	...	...	...	...	...	...	6	...	...	...	6
D. L. & W.	54	56	40	...	12	...	1	...	3	17	23	16	...	40	...	16
D. & R. G. W.	49	49	28	...	12	...	7	...	2	...	...	49	...	...	...	49
Erie	40	40	30	...	7	...	...	...	3	1	...	...	39	1	39	...
Fla. East Coast	32	32	22	...	10	...	...	...	...	...	...	...	32	...	32	...
Great Northern	63	73	42	...	28	...	...	...	3	...	12	61	...	12	...	61
G. M. & N.	12	12	5	...	2	...	...	4	1	7	5	...	...	12	...	...
Illinois Central	160	160	99	10	35	10	2	...	4	12	135	13	...	147	...	13
Lehigh Valley	15	16	4	...	8	4	...	...	...	16	...	...	...	16	...	...
L. & N.	135	135	119	...	16	...	...	...	...	...	...	...	135	...	135	...
Maine Central	17	17	15	2	...	...	...	...	...	...	...	17	...	...	...	17
M. St. P. & S. Ste. M.	9	11	...	...	3	...	4	4	...	7	...	4	...	7	...	4
M.-K.-T.	26	46	...	...	12	28	5	...	1	6	...	3	37	6	37	3
Mo. Pac.	273	273	101	31	58	63	11	...	9	26	1	206	40	27	40	206
Mobile & Ohio	...	2	...	...	2	...	...	...	...	...	2	...	...	2	...	...
N. C. & St. L.	31	31	25	...	6	...	...	...	...	...	...	...	31	...	31	...
N. Y. C. System	312	320	183	1	132	2	1	...	1	247	58	15	...	305	...	15
N. Y. C. & St. L.	21	21	15	...	4	...	...	...	2	...	21	...	...	21	...	...
N. Y., N. H. & H.	387	437	379	17	35	6	...	...	...	304	...	133	...	304	...	133
Norfolk & Western	120	125	89	19	11	...	...	...	6	115	...	6	4	115	4	6
Northern Pacific	83	95	46	...	30	3	14	2	...	...	95	...	...	95	...	...
Pennsylvania	605	610	338	105	167	...	...	...	...	188	2	419	1	190	1	419
Pullman Co.	4,839	5,055	...	...	9	399	494	4,153	...	188	3,097	1,356	414	3,285	414	1,356
Reading	63	63	41	11	9	...	2	...	...	63	...	...	...	63	...	...
R. F. & P.	25	25	14	2	8	...	...	...	1	13	9	1	2	22	2	1
St. L.-S. F.	102	114	46	10	28	21	2	2	5	1	22	91	...	23	...	91
Seaboard A. L.	95	99	51	17	27	...	...	...	4	4	95	...	...	99	...	...
Southern	36	142	81	27	34	...	...	...	...	...	...	...	142	...	142	...
Southern Pacific	399	399	169	2	103	113	4	...	8	...	100	225	74	100	74	225
Texas & Pacific	61	61	39	...	12	4	4	...	2	1	9	21	30	10	30	21
Union Pacific	318	321	63	...	85	129	37	5	2	26	231	...	64	257	64	...
Wabash	66	66	18	...	18	27	...	...	3	...	...	66	...	...	...	66
Western Pacific	15	15	7	...	5	...	3	...	...	3	...	...	12	3	12	...
Total	10,840	11,676	3,301	391	1,473	1,133	640	4,660	78	1,850	4,184[4]	4,055	1,587	6,034	1,862	3,780

Note 1—Includes lounge-diners, coach-diners, cafe-chair, cafe-coach, kitchen-coach and buffet cars.
Note 2—Includes lounge-chair, coach-chair and observation-chair cars.
Note 3—Includes lounge- and observation-sleepers.
Note 4—Total for direct mechanical systems includes 323 cars on which the compressor is driven by a gas engine.

Wet-Bulb Thermostat Controls

Air-Conditioning Unit

THE Vitalized air-conditioning system of the B. F. Sturtevant Company, Hyde Park, Boston, Mass., consists essentially of a blower and spray-cooling unit, an ultraviolet-ray sterilizer, and a wet-bulb thermostat control.* The wet-bulb thermostat is designed to operate in conjunction with other control apparatus of any standard or special design for the control of temperature and humidity in passenger cars. Its function is to produce economy in ice consumption in cars equipped with ice-chilled-water air-conditioning systems and to reduce the maintenance of Freon of steam-jet-equipped cars by effecting more continuous operation.

The thermostat consists essentially of a small hard brass alloy reservoir to which a supply and return-water connection is made from the main spray nozzle water-pumping system through a small copper tube. This tubing is installed as readily as electric wiring since it can be bent around corners and connected with standard flared fittings. Insulation against sweating is provided by standard commercial hollow-sponge rubber tubing and felt where necessary.

A few drops of water each minute (depending upon evaporation) find their way from the reservoir into a special leather sack or boot which becomes uniformly wetted over its entire outer surface. This water evaporating from the surface cools the interior of the boot to the wet-bulb temperature of the surrounding air. A mercury thermometer inserted into the sack, therefore, records this wet-bulb temperature.

At a predetermined point in the stem of the thermometer, corresponding to a given wet-bulb temperature, a wire is fused through the glass to contact the mercury when it rises to the proper wet-bulb temperature. Thus an electrical connection is established and the circuit completed through a relay whenever the mercury is at the desired wet-bulb temperature or higher. When the wet-bulb temperature is lower the electric circuit is opened and the relay de-energized. The entire device is placed in the outside air intake opening of the passenger car so that at all times, while the air-conditioning system is in operation, the wet-bulb thermostat is subjected to an ambient temperature corresponding to the outside air.

The relay is in turn connected electrically into the main air-conditioning control panel to operate a damper motor which will change an automatic damper setting from approximately 25 per cent outside air to below 100 per cent outside air and vice versa. At all outdoor wet-bulb temperatures above the predetermined temperature the dampers will shift to admit 100 per cent outside air. Thus the car is provided automatically with 100 per cent clean, fresh, washed and filtered outdoor air at all times when weather permits and at all other times with 25 per cent outdoor air and 75 per cent recirculated, but still washed and filtered air.

At no time is the mechanical refrigeration apparatus beneath the car overloaded. In fact, it is kept in more continuous operation by the control since the dampers reset automatically under wet-bulb temperature control to maintain a more nearly constant load upon the evaporator.

Cars equipped with ice-chilled-water systems will cool by evaporative cooling and consume no ice for refrigeration during the period when the dampers are set automatically to 100 per cent outdoor air.

Standard coach control panel, including wet-bulb thermostat connections

An automatic water-regulating valve and a water strainer are provided with each wet-bulb thermostat. These devices need only occasional attention. Experience has shown that when properly adjusted the valve will regulate the proper water flow for an entire summer without attention and the strainer need be cleaned no oftener than once or twice a season.

The wet-bulb thermostat may also be used for regulation of the ultraviolet sterilizer at all times when the outside air dampers are set to the 25 per cent position. This would include the heating season and periods when mild weather conditions exist out of doors, such as in the spring and fall, and summer mountain weather at high altitudes. The relative humidity of the car may also be regulated uniformly without window condensa-

* A description of this equipment appeared in the December, 1937, issue of the *Railway Mechanical Engineer*, page 564.

tion under such weather conditions. Water freezing temperatures cannot damage the control and, in most installations, the water will dry from the leather boot and drain from the reservoir when the main pump stops long before freezing weather exists. The control will also regulate the ice-water bypass valve in cars equipped with ice-chilled-water systems so that water will not pass through the ice bin during the evaporative cooling setting of the outside air dampers. This is essential for ice economy. On mechanically refrigerated cars the control can be made to shut down the compressor completely when evaporative cooling is possible.

The principle of the application of the wet-bulb thermostat to railway cars depends upon the fact that the quantity of heat in air at any given wet- and dry-bulb temperature is determined by the wet-bulb temperature. In a conventional type of railway car full of passengers the usual maximum wet-bulb temperature of the air entering the evaporator coil (mixed outdoor and recirculated air) is in the neighborhood of 70 deg. F. The evaporator must cool this air to a wet-bulb temperature of approximately 55 deg. under maximum load conditions. The refrigeration tonnage rate requirement is determined as a function of the difference between these two wet-bulb temperatures.

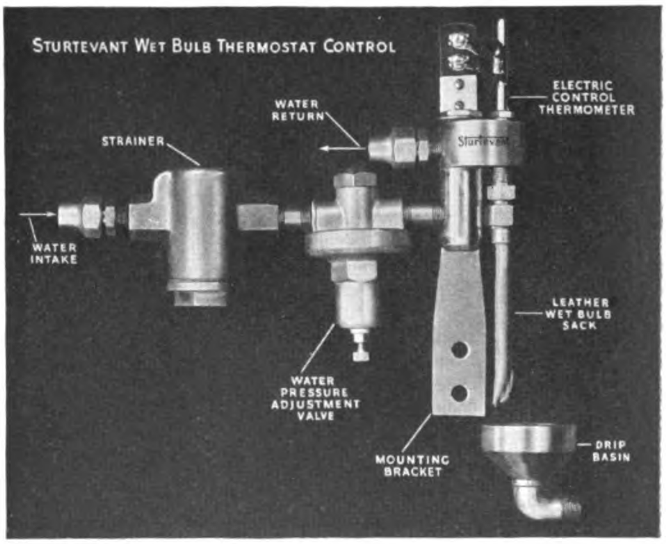
But there are many times when maximum conditions of outdoor temperature do not exist. If at such times a damper could be adjusted to admit outdoor air with no recirculated air and water sprays could be directed into intimate contact with the outdoor air to remove dust and secure the necessary benefit of evaporative cooling plus refrigeration, it would be possible to reduce odors and bacteria in the car by the very fact that the car would be ventilated by 100 per cent outdoor air, practically sterile and odor-free.

A 70-deg. F. wet-bulb temperature thermostat supplemented with water sprays and refrigeration will bring this about and make possible the introduction of 100 per cent outdoor air at all times when the outdoor wet-bulb temperature is low enough (70 deg. F. or less) not to overload the existing mechanical refrigeration apparatus.

Careful daytime studies of government weather bureau records indicate that trains running through territories in the vicinity of Philadelphia to St. Louis, to Dallas, Tex., or through regions north or west of this route can be operated with 100 per cent outdoor air under wet-bulb thermostat control slightly over 50 per cent of the time during a typical summer of June, July, August and September.

During the remainder of the time resort must be made to air conditioning with partially recirculated air. Under these circumstances the recirculated air and the outdoor air are then passed through the coils of the evaporator and washed with water sprays. The recirculated air is treated intensely with ultraviolet radiations to imitate the lethal action of sunlight upon bacteria and other micro-organisms. The ultraviolet sterilizer is said to produce a bacteriological result in a car equivalent to that which was obtained by the introduction of 100 per cent (approximately 2,000 cu. ft. per min.) outside air through the air-conditioning system into the car. The total power input to the sterilizer is about 12 amp. at 38 volts.

The ultraviolet sterilizer was first operated in railway service during the fall of 1937 after laboratory tests to establish the design had been completed. A careful check upon the apparatus in actual service at the end of the winter season disclosed remarkable agreement with laboratory tests and germicidal benefits from the lights as predicted. The regular sterilizer equipment produces no perceptible quantity of ozone, but when the presence



The wet-bulb thermostat control permits the admission of one-hundred per cent outside air in mild weather

of the small quantities of ozone found in mountain air are desired, special ultraviolet lights may be provided in combinations to meet any desired standards.

It can be shown that the application of vitalized air conditioning to railway cars will result in a saving of maintenance expense of existing mechanical equipment through less frequent starts and stops. The conventional air conditioning system of today is designed for about six or seven tons per 24 hours' refrigerating capacity. Under such loads the compressor will operate almost continuously, but at other times the refrigeration load is reduced sufficiently to make it necessary for the controls to stop the compressor more or less frequently, depending upon the mildness of the day and the number of passengers in the car.

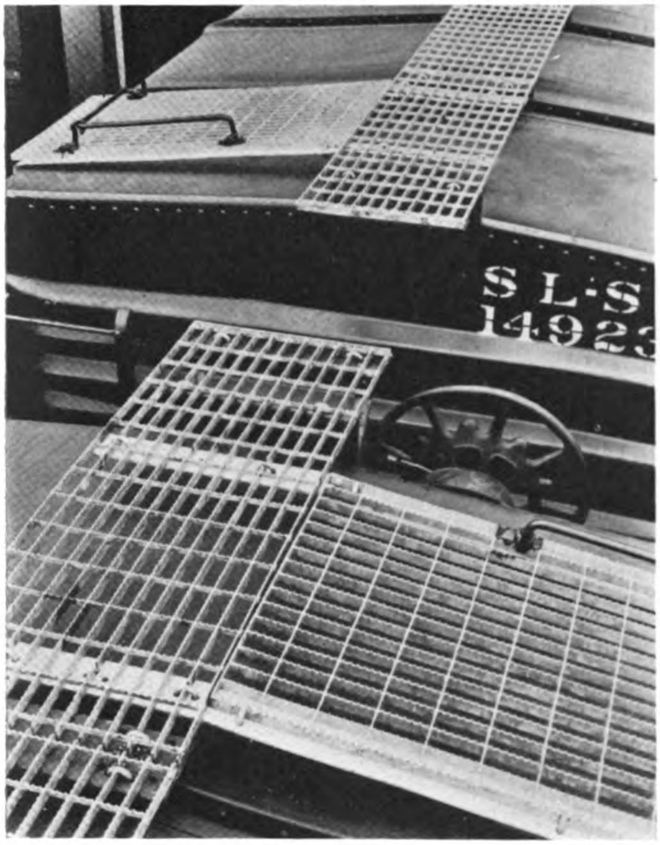
When the wet-bulb thermostat shifts the damper setting to 100 per cent outdoor air, the effect or recirculated air upon the operation of the system is, of course, removed. Under such circumstances a more continuous operation of the compressor equipment is made possible. Furthermore, the compressor equipment will shut down completely, allowing the water sprays to exert a cooling action by evaporative cooling under mild weather conditions and in favorable sections of the country.

Savings because of the absence of the need of removing evaporator coils and blowing them out with steam or chemicals to render them free of odor-producing collections of scum and algae growth are indicated. It is also expected that less frequent cleaning of the air ducts will be necessary.

Apex Safety-Steel Running Board

A new type of metal running board for all kinds of box cars, as well as running boards for locomotives and locomotive tenders, has recently been developed and placed on the market by the Apex Railway Products Company, Chicago.

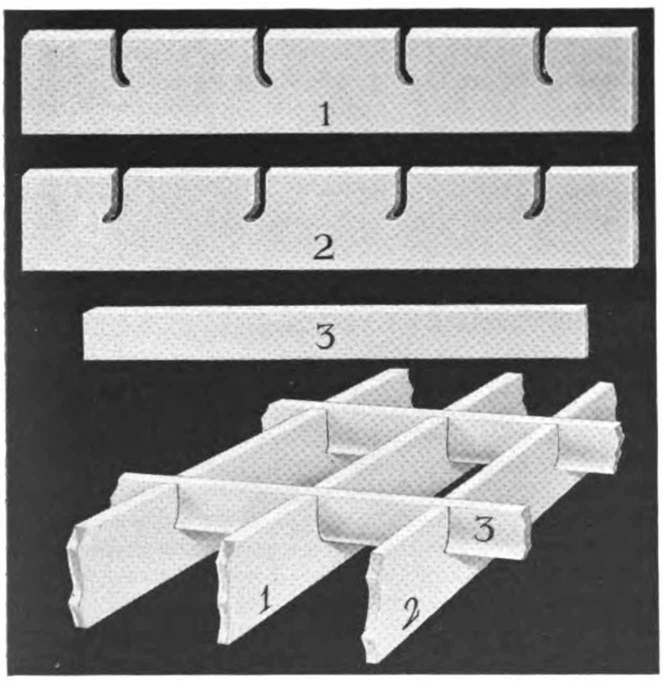
This running board is of the grating type with both the longitudinal and latitudinal bars serrated to assure safe footing for trainmen and other employees, regardless of weather conditions. The running board utilizes the Tri-Lok method of fastening the bars together, the Apex Railway Products Company having been exclusively licensed by the Tri-Lok Company, Pittsburgh,



Details of application—note the serrated top surfaces

Pa., to use this method of construction in making running boards for use on all railroad rolling stock.

In assembling, the bearing bars are set on edge with a series of J-slots uppermost and with these slots in adjacent bars curving alternately in opposite directions. Each bar is held in a rigid steel frame assuring accurate alinement. Cross bars of the same depth and width as the bearing bar slots, are then forced into the slots, under a 1,600-ton press. This completes the triple twist and turn lock from which the name Tri-Lok is derived.



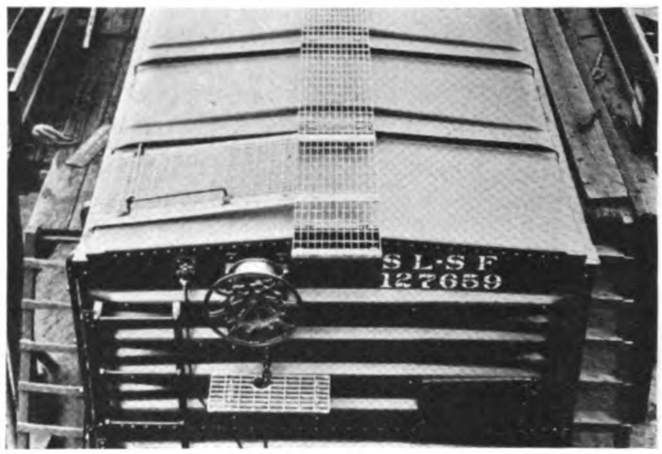
Principle of construction of the Apex tri-lok running board

The Tri-Lok bearing bars are not punched or cut below the neutral axis, so that the strength of the lower or tension side is unimpaired. The wedge action from forcing the cross bars into the curved locking slots is said to increase the strength of the upper or compression side and hence make the load-carrying capacity of the bearing bars greater than that of corresponding solid bars.

The cross bars are of sufficient depth to eliminate lateral deflection of the bearing bars and, because of the rigid lock at the joint, they act also as cross braces giving an even distribution of a concentrated load over a wide panel. The rigidity of this construction permits the use of light sections, with the result that this metal running board is, in certain cases, even lighter than the standard wooden running board.

The material is made up of 0.25-per cent carbon, copper-bearing steel and the separate units which make up the complete running board are hot-dipped galvanized after the entire assembly has been completed. It is estimated that this running board will last the life of the car without maintenance costs of any kind.

The serrated top surface of this running board presents a safe walking surface regardless of weather conditions. The serrations are sufficiently sharp to crush sleet or ice under a man's weight, and the spacing between the bars is sufficient to furnish an available hand hold in case of emergency. It is likewise claimed that this running board will be self-cleaning due to the fact that it presents a 90 per cent open area. Under ordinary conditions it will be impossible for snow to collect to a sufficient depth to cover the serrated walking surface.



Apex tri-lock running board and handbrake step applied to a box car

The Apex Tri-Lok running board consists of seven sections on a standard 40 ft. car. The five center sections are approximately 81 in. long and are spaced ¼ in. apart. The end sections vary according to the exact dimensions of the car and are purposely kept smaller to insure lower replacement costs in the event that the car is cornered in service.

These sections can be attached to the standard saddles now in use and the method of fastening will make possible the use of standard A. A. R. ⅜-in. bolts or rivets. The application of this type of running board entails the use of 63 standard ⅜-in. bolts complete with lock nuts as compared to 90 ⅜-in. by 1¾-in. water-tight, slotted head bolts and 12 ⅜-in. by 2-in. water-tight, slotted head bolts used on the wooden running board.

Latitudinal or transverse running boards and the hand brake steps or platforms, are also furnished by the Apex Railway Products Company in the same general type of design.

EDITORIALS

Some Light on Deferred Maintenance

According to a report of the Interstate Commerce Commission, based on the replies to a deferred-maintenance questionnaire which was sent out in December, 1938, the Class I railroads had deferred maintenance at the end of 1938 amounting to $283,820,000, which would need to be made up in order to put the properties in normal condition to handle during the current year a volume of traffic as large as that of 1937. The report further indicates that $495,757,000 should be expended during the three-year period 1939 to 1941 for additions and betterments and extensions to enable the carriers to handle this volume of traffic more cheaply and expeditiously. Of the $283,820,000 of deferred maintenance, an average of only $73,676,000 per year, or a total of $221,027,000, would need to be made up during the next three years. The questionnaire further asked how much these totals would be increased if a traffic 10 per cent greater than that of 1937 were assumed for 1939. The replies indicated an increase in the amount of deferred maintenance of $94,852,000 and an increase in the amount needed for additions, betterments and extensions of $19,991,000.

Of the $283,820,000 of deferred maintenance reported, $84,173,000 was for repairs to existing cars and locomotives and $37,276,000 was for additional equipment. More new equipment was also included in the $495,757,000 reported as the needs for additions and betterments. Deferred maintenance of shop machinery and tools is reported in the amount of $3,574,000, of which slightly less than $2,000,000 would be charged to investment. This also is in addition to expenditures for new shop machinery and tools included in the $495,757,000 of additions and betterments.

As pointed out by one of the railroads in its report to the Commission, "current expenses for maintenance compared with expenditures for past years are no criteria for determining whether any deferred maintenance has accrued because of larger and improved machines installed in recent years as well as improved methods now used for doing maintenance work which were not previously available." Selected statistics, included in an appendix to the report which relate to maintenance from 1929 to 1937 on the large steam railroads with annual operating revenues above $25,000,000, throw considerable light on this phase of the situation. As a measure of the transportation performance by which the need for maintenance expenditures is created, 100 car-miles has been chosen as a unit. Man-hours paid for in maintenance of equipment and stores is selected as an index of the amount of maintenance put back into the equipment. The trend of this ratio since 1929 for the Eastern, Southern and Western Districts is shown in the table. Assuming that there had been no change in maintenance efficiency, the reduction of man-hours per 100 car-miles during the years since 1929 indicates roughly a volume of deferred equipment maintenance amounting to about $1,000,000,000. The total figures for deferred maintenance of equipment in the report, including both the requirements for repairs and for new equipment, amount to $121,500,000—about one-eighth of the hypothetical total.

It is, of course, reasonable to assume that, if the standard of comparison were a condition of the property equal to that existing in 1929, the amount of deferred equipment maintenance shown would be greater than the $121,000,000 represented by a prospective volume of traffic equal to that of 1937. Much of this would be additional equipment required to restore the capacity of the property to that available in 1929 and would be necessary because of extensive retirements unbalanced by adequate acquisitions of new units of equipment during the intervening years.

A point of particular interest in the report is the fact that, of the 115 replies received, only 67 replies are represented in the deferred maintenance total, of which 44 were for railroads or systems not in the hands

The Trend of Maintenance of Equipment Expenditures in Relation to the Volume of Transportation Service

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Eastern District									
Car-miles in transportation service (000,000)	13,652	12,001	10,269	8,221	8,291	8,666	8,688	9,742	10,162
No. man-hours per 100 car-miles (Maintenance of equip. and stores)	3.62	3.47	3.21	3.05	2.87	3.01	2.92	3.09	3.09
Maintenance of equipment expenses (000,000)	571	475	376	281	270	285	300	357	374
Southern District									
Car-miles in transportation service (000,000)	6,299	5,731	4,927	3,890	4,079	4,316	4,357	4,969	5,169
No. man-hours per 100 car-miles (Maintenance of equip. and stores)	3.50	3.24	3.04	2.93	2.72	2.90	2.74	2.74	2.71
Maintenance of equipment expenses (000,000)	212	181	150	113	113	121	133	144	150
Western District									
Car-miles in transportation service (000,000)	13,701	12,330	10,345	8,205	8,194	9,155	9,413	10,801	11,442
No. man-hours per 100 car-miles (Maintenance of equip. and stores)	3.16	2.94	2.69	2.58	2.44	2.43	2.46	2.45	2.52
Maintenance of equipment expenses (000,000)	421	364	292	225	215	232	248	282	303

of the courts, and 23 for properties in receivership or trusteeship. The report questions the validity of returns indicating no deferred maintenance for so many roads, on the presumption that they may have understood the term "deferred maintenance" as used in the questionnaire in too narrow a sense. It arrives at a total of $444,000,000 by assuming amounts of deferred maintenance for these roads on the same percentages of their operating revenues as were averaged by the reporting roads.

Aside from the very material increases in the efficiency of equipment maintenance which have been developing throughout the past ten years, a considerable volume of deferred maintenance has been permanently removed from the future requirements for repairs by the accelerated rate at which both freight cars and locomotives were retired during the depression years. This will, of course, appear progressively as demands for new equipment when traffic volume catches up with and begins to exceed the capacity of the present equipment inventory.

While the report does not show the full amount of deferred maintenance suffered by the railroads since the beginning of the depression, it probably presents a good idea of the practical needs of the properties to meet the conditions likely to be faced within the next year or so. With a return of some measure of prosperity to the railroads, much more would be spent in raising the general standards of maintenance to higher levels than those now prevailing, which represent the minimum needs for safety and a capacity only just sufficient for the immediate future.

Fewer Machine Tools And Tool Supervisors

The general trend, both in the installation of modern machine tools in railroad shops, and in the provision of an adequate number of tool foremen or supervisors to develop needed accessory equipment and keep present jigs, fixtures, cutting tools, etc., in good working condition, has been downward for a number of years past. According to a recent report of the United States Bureau of the Census, 291 companies were engaged in the manufacture of machine tools in this country during 1937. How many railway machine foremen and even general supervisors of shop machinery and tools know *all* of these companies; understand or appreciate the adaptability of their respective products to railway shop operation; and are in a position to give a reasonably accurate estimate of the attendant economies?

The total value of all machine tools manufactured in 1937, including replacements and repair parts, is given in the Bureau of the Census report as $216,000,000. Figures compiled by the Interstate Commerce Commission, Bureau of Statistics, show that Class I railroads spent only $6,710,000 for new shop machinery chargeable to additions and betterments in 1937. Further curtailments of railway machine tool purchases took place in 1938, as shown by a recent *Railway Mechanical Engineer* study which indicated that 15 new boring machines, 21 drilling machines, 32 engine lathes, 8 milling machines, and other tools in proportion, were installed during the year. Both railroads and railroad shops are "tinctured with a public interest," and, therefore, must continue to operate on a long-time basis. This means that deficiencies in rolling stock and the machinery required to maintain it may, on account of financial stringency, be allowed to accumulate for a number of years, but, in the long run, must be largely made up. The record of relatively few machine tool purchases in recent years is evidence in itself of a condition of shop machinery obsolescence which in the end will have to be corrected.

Equally important with the mechanical tools and equipment which should be installed to bring railway shops up-to-date is the provision of an adequately trained and experienced supervision to make sure that full advantage is taken of modern shop tools and machinery when placed in service. Without competent supervision to assure proper operation and develop special tooling equipment required in railroad shop machining operations, it is obvious that expected economies will not materialize. Have shop supervisors, including general foreman, enginehouse foremen, machine foremen and tool foremen been encouraged to study machine production methods, read technical publications in this field, visit well-equipped plants and thus become familiar with the latest and best practices not only in other railroad shops but in manufacturing plants where similar operations have to be performed? The answer must be, in general, No. Railroad supervisory forces have been cut to the bone, many individuals reduced in rank and the position of tool foreman pretty nearly abolished.

The fact just stated is, of course, responsible for the practically complete discontinuance of the American Railway Tool Foremen's Association, which could not get enough active members to continue its meetings subsequent to 1930 and had to "shut up shop." This association has in the past done some excellent work in the interests of economy on the railroads and at its last meeting was engaged in standardizing certain small tools which promised to be a constructive service not only to the railroads but to the manufacturers, who expected to be able to supply improved standard tools at reduced cost. It is unfortunate that this work had to be discontinued and also that the association could no longer serve as a clearing house for ideas regarding shop machinery and tool improvements.

Tool foremen, in the nature of things, are responsible for the development of many of the special jigs, fixtures and attachments which serve to increase the productive capacity of machine tools and reduce the unit costs. The proper maintenance of this equipment, as well as the task of specifying cutting tools which

will produce desired results at the least cost, and keeping these tools in condition for efficient use, constitutes a real problem which confronts all tool foremen. It is a distinct detriment to railroads to lose the services of these men, or lower their morale by reducing them to the ranks and expecting them to do more or less the same work at reduced pay. Such action may be temporarily forced by a drastic retrenchment program, but should obviously be "reversed and remanded" at the first opportunity.

Nine Years Progress in Railway Air Conditioning

Almost 10 years ago, in September 1929, the Pullman Company placed in service the first air-conditioned passenger car to be operated in this country and seven months later the Baltimore & Ohio equipped the diner "Martha Washington". In April 1932 the Baltimore & Ohio inaugurated the first completely air-conditioned train, the National Limited. These were the events that introduced a new era in passenger transportation by rail during which the Pullman Company and the roads of this continent have equipped 11,676 passenger cars at an expenditure in excess of 80 million dollars.

On page 139 of this issue there appear, for the sixth consecutive year, the tabulations of the passenger cars that were equipped with air conditioning apparatus during the year 1938 and a summary of the installations for the entire nine-year period of this development. These statistics are interesting because they not only show the extent and character of the work that has been done in this field but they show the trends as experience with air conditioning broadened.

A study of these figures indicates that 67 per cent of the cars owned by the Pullman Company are now air-conditioned and, incidentally, the total number of air-conditioned Pullman cars at the end of 1938 represented over 97 per cent of the Pullman cars operated in 1938. From the railroad standpoint the total installations represent about 23 per cent of the passenger-carrying cars owned by U. S. roads. Of the 5621 railroad-owned air-conditioned passenger-carrying cars (exclusive of Canadian equipment) 3,126 are coaches, 387 are combination cars and 1,309 are grouped together as dining, chair, sleeping, club, lounge and observation cars. These represent, respectively 17 per cent, 12 per cent and 90 per cent of their classifications owned by U. S. roads. It is obvious that there is a lot of work still to be done in extending the comforts of air-conditioned travel to the coach passenger.

Of the 11,676 cars in service in North America 51.5 per cent are equipped with mechanical refrigeration systems, 35.5 per cent with the ice-activated system and 13 per cent with the steam ejector system. Of the 6,034 cars equipped with mechanical systems all but a very few of the early cars use Freon as a refrigerant. Over 300 cars have gas-engine-driven compressors.

New Books

FORGING PRACTICE. *By Carl G. Johnson, assistant professor of mechanical engineering, Worcester Polytechnic Institute. Published by the American Technical Society, Drexel avenue at Fifty-eighth street, Chicago. Price, $1.50. 136 pages, illustrated.*

How and why certain physical changes occur within metal being worked, and how the results produced by forging can be controlled not only as to shape, but also as to structure and physical properties in the finished forging, are discussed in Forging Practice. Many other phases of plastic shaping are considered in the book which is a practical treatise on hand forging of wrought iron, machine steel and tool steel; drop forging; and heat treatment of steel, including annealing, hardening and tempering.

OXYACETYLENE WELDING. *By Robert J. Kehl, M. E. Revised by Morgan H. Potter, B. S., instructor in charge of welding, William Hood Dunwoody Industrial Institute, Minneapolis, Minn. Published by the American Technical Society, Drexel avenue at Fifty-eighth street, Chicago. 126 pages, illustrated. Price, $1.25.*

The material in the revised edition of Oxyacetylene Welding has been written for the welding operator as well as for the superintendent and manager. It is written in the "how-to-do" style and the examples it contains have been taken from many industries. The thirteen chapters in the book are on the Oxyacetylene Process, Technique of Oxyacetylene Welding, Welding for Different Metals, Steel Welding, Cast-Iron Welding, Welding at Vertical and Overhead Positions, Pipe Welding, Miscellaneous Processes, Welding Miscellaneous Metals, Cutting and Lead Burning, Welding in Automobile Repair Work, Design of Jigs for Oxyacetylene Welding, and Costs.

CAR DEPARTMENT OFFICERS' PROCEEDING. *Published by the Association; bound in cloth and comprising 162 pages, 5 in. by 8½ in. Secretary-Treasurer F. L. Kartheiser, chief clerk-mech. Chicago, Burlington & Quincy, 547 W. Jackson boulevard, Chicago. Price $2 (including annual membership dues).*

Containing the official proceedings of the second annual meeting of the Car Department Officers' Association at Chicago on September 27 and 28, this well arranged and carefully edited book presents a large amount of information of value to railway car foremen and supervisors of all ranks. The discussion of various important details of car construction, included in this book, is particularly pertinent. Other reports deal with such subjects as: shop operations, facilities and tools; passenger train car terminal handling; lubricants and lubrication; freight-car inspection and preparation for commodity loading; interchange; loading rules; and billing for car repairs.

THE READER'S PAGE

Exchange Ideas on Equipment Maintenance

To the Editor:

Through the medium of the columns of the *Railway Mechanical Engineer* there appears to be a valuable opportunity for exchanging ideas relative to equipment maintenance. I have always felt that real sympathy should exist between kindred departments on all railroads, which in turn would bring about this exchange of ideas and ultimately result in establishing the most efficient and economical method of operation.

I write primarily from an air-brake standpoint. The average air-brake department is left very much to its own resources and, on account of the intricacies and technical difficulty of the work involved, is avoided very much by many who could be of real help. It therefore becomes more or less like Topsy who "just growed up."

We are now entering upon a new era in so far as the air brake is concerned; namely, the adoption of the Type AB brake as standard on all freight cars by January 1, 1945. When the entire ownership of approximately 1,950,000 freight cars is so equipped, it will represent an investment of about $328,029,000. This enormous sum of money can and should be made an investment upon which good returns will be realized, but to do this will require both proper organization and proper equipment. The object of such organization should be efficient, safe, and economical maintenance, and this is where the exchange of ideas becomes a most important factor in attaining the desired result.

Why should we be jealous of, and refuse to share with, our neighbor something that we have discovered that helps us in our work? Can't we realize that by helping others we are helping ourselves; this being accomplished by reinforcing and perfecting the entire structure of maintenance?

In the September, 1937, issue of *Railway Mechanical Engineer* there were illustrated several ideas that we had developed and had proved to be very efficient in making repairs to the Type AB valve. We thought that, inasmuch as these tools had helped us, their extended use would surely help others, so we passed these ideas on. We then patiently waited for each succeeding issue of the magazine, hoping to find something described therein that would help us in this AB valve maintenance. In other words, we expected to find a real spirit of reciprocity, but up to date nothing has appeared and I am wondering whether it would not be a good investment of time and money if a kind of clearing house for ideas were established, a place where all methods of maintenance would be collected, thoroughly analyzed by practical men, and the best way determined and made uniform standard practice. A procedure of this nature would also be a boon to safety, as it would be possible to cull out all unsafe practices.

Assuming an ownership of 50,000 cars on an individual railroad, over $100,000 will be spent annually for maintaining the AB brake, as per A. A. R. Rule 60. This sum represents the money that will be spent to protect an investment of $8,411,000, which is the approximate cost of 50,000 car sets of AB brake equipment. Surely an investment of this magnitude should invite serious thought and particularly the co-operation of all air-brake maintenance men, to the end that air-brake equipment will be kept up to the highest point of efficiency at the lowest possible cost. This can be done only by exchanging ideas so that ultimately only the best practices are used.

I feel sure that the *Railway Mechanical Engineer* will gladly open its columns for this exchange of ideas, with sketches of devices, and other valuable information gleaned from the experience of maintaining the AB brake equipment, and it is hoped that such invitation will be extended so that we all may profit from the various experiences gained from the work.

T. H. Birch,
Air Brake Foreman,
Chicago, Milwaukee, St. Paul & Pacific

Compensation for Worth-While Ideas

To the Editor:

Your editorial in the February issue, page 63, relative to "The Patent Problem," is indeed pertinent and should receive the careful perusal of every railway executive who has the responsibility of assisting in the development of the industry.

Certainly some consideration and encouragement should be given the inventor of devices that improve or provide economy and safety in mechanical performance. This, of course, refers to those inventions having commercial possibilities as well as domestic application.

If the railroads are to keep pace with other modern means of transportation, new devices must come into use to offset competitive transportation facilities, which are continually improving. While competent professional designers do contribute, they cannot think of everything. The man in overalls may have a splendid idea, but unless he is encouraged to develop it with fair remuneration for his painstaking efforts, it is likely to remain just an idea.

Just as patent monopoly by manufacturers stagnates progress, so, too, does the indifferent attitude of management to the ideas of employees. True enough, the "suggestion box" is some encouragement, but only for small ideas with small remuneration. Certainly an inventor after much study and painstaking effort, will not entrust an idea with commercial possibilities to the discretion of those in charge of the "suggestion box." He will take the matter up with those whose duty it is to consider it for the benefit of the industry, and, if he receives no encouragement, he will probably patent the idea at his own expense, only to find that his troubles have just begun. You may be sure that after he is thoroughly disillusioned he will waste no more time on ideas that require study and painstaking effort.

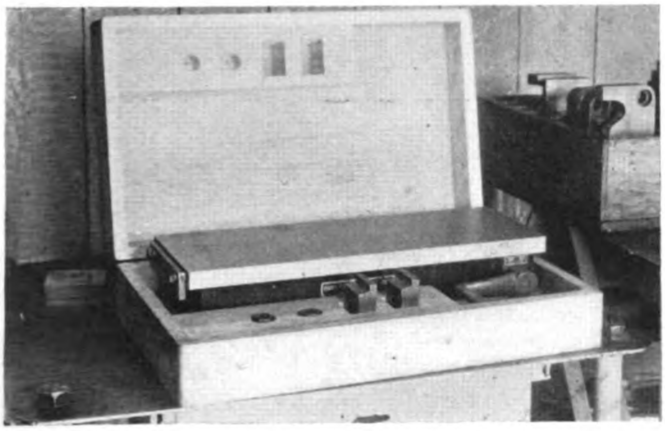
We have reached the "frontier of research, new discoveries, new inventions," but we must go on. "This frontier need never be closed." The ideas of the individual are needed to expand it. I hope you will continue to write editorials on this subject.

F. R. Richard

IN THE BACK SHOP AND ENGINEHOUSE

Permanent Type Magnetic Chuck

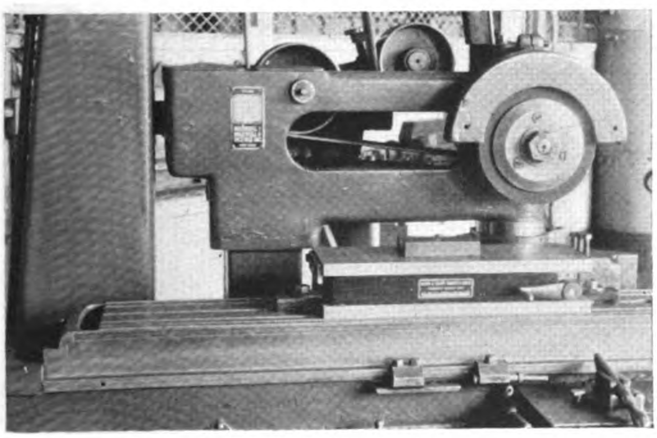
An interesting and valuable new tool, recently installed in the tool room of the Union Pacific locomotive shops at Omaha, Neb., is the Brown & Sharpe magnetic chuck, illustrated. This chuck, which is of the permanent-magnet type and requires no electrical connections, has a working surface 6½ in. wide by 18 in. long and is operated simply by turning a handle on one end 180



Convenient wooden box designed for the safe keeping and handling of the permanent magnetic chuck and its associated parts

deg. from the *Off* to the *On* position. The operation of moving parts within the chuck body serves to short-circuit the lines of magnetic force and release the metal part being machined, or leave the lines of force unbroken and hold the part firmly against the upper surface of the chuck, dependent upon which is desired.

The convenience of this magnetic chuck, with complete absence of electrical connections, is readily apparent and it can be clamped on the work table of any ordinary machine tool or surface-grinding machine by means of two dogs and T-slot bolts, as illustrated. The chuck is particularly useful when taking finish-grinding



Brown & Sharpe magnetic chuck of the permanent-magnet type used in finish grinding a special forming tool

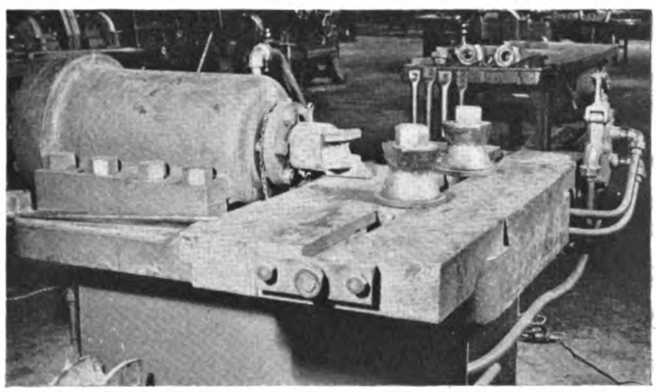
cuts on such parts as wheel-lathe forming tools, shear blades, etc. In one of the illustrations, the chuck is shown on a Thompson grinder holding a special forming tool used in machining passenger car center castings. For light grinding operations, no positive mechanical stop is required to supplement the holding power of the magnet, but it is advisable to use the stop when taking light milling cuts.

This magnetic chuck is also useful at work benches in holding various parts while being filed, especially thin material which would be difficult to clamp in a vise. Referring to the second illustration, the special wood box with hinged cover, which is used to hold the magnetic chuck and associated parts and keep them safe at all times when not in use, is shown. The provision of this box may seem like a small and unimportant detail, but it is in line with the fixed policy in this particular railway tool room of taking the best care possible of the many highly-accurate and finely-finished tools, gages, etc., which experience has shown that it pays to buy and use, in spite of their relatively high first cost.

Hydraulic Pipe Bending Machine

The accompanying illustration shows a hydraulic pipe bending machine designed for the cold bending of various sizes of pipe. Any size pipe, up to and including 4 in. extra-heavy, can be successfully shaped cold.

The cylinder has a bore of 12 in., and is fitted with a



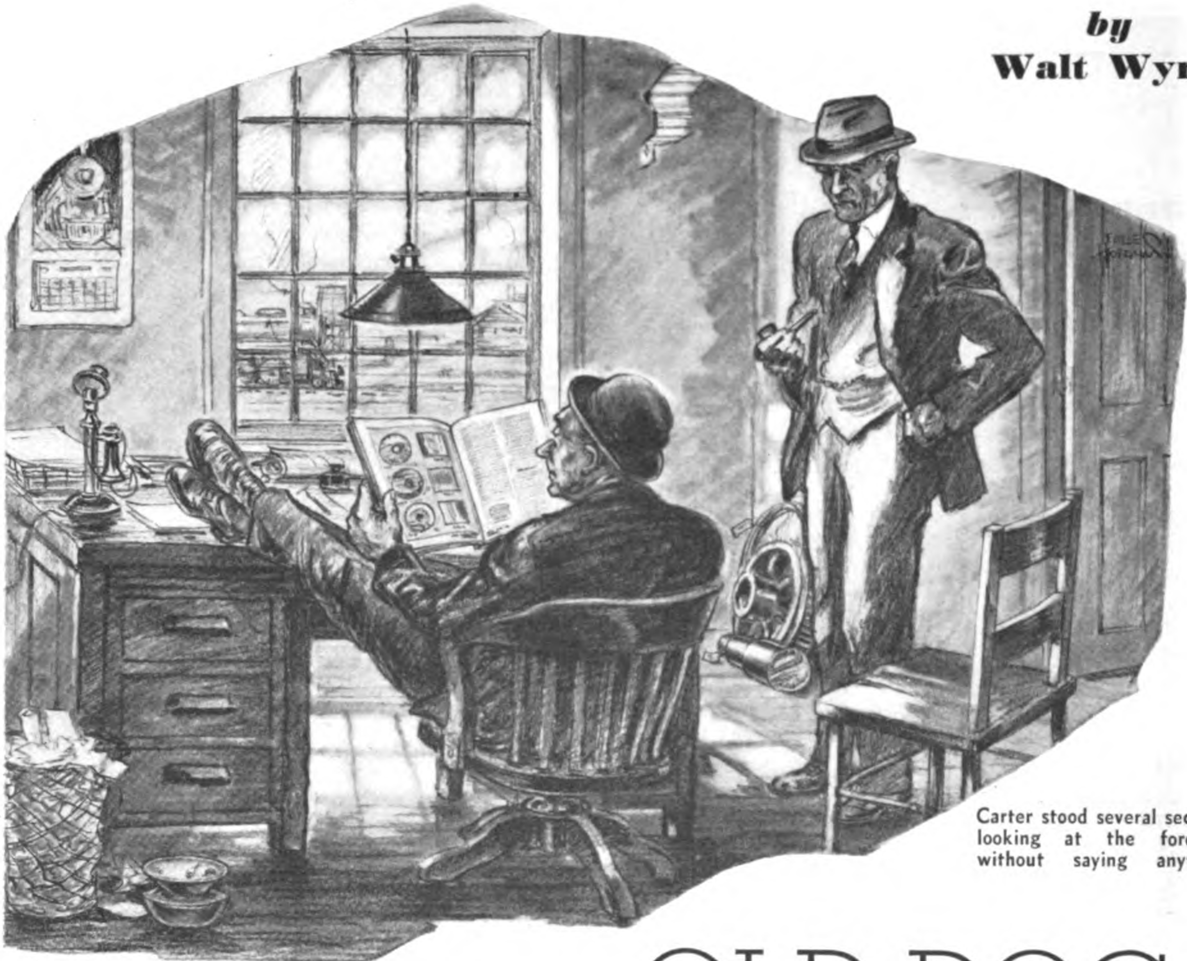
Machine for bending pipe cold

piston having the usual hydraulic packing leather for forward and return stroke. The 4-in. piston rod was made from an old locomotive piston rod.

In order to bend the different sizes of pipe, cast iron bending dies are made to suit each size of pipe. These slip on to the end of the piston rod and are held in place by a pin. In order to get bends of different radii, the two spools are mounted on a steel nut with a spindle. The nuts are threaded right and left hand so the spools can be placed any distance apart to obtain the different

(Continued on page 155)

by
Walt Wyre



Carter stood several seconds looking at the foreman without saying anything

OLD DOG — NEW TRICKS

"RAILROADING ain't what it used to be," John Harris, roundhouse clerk for the S. P. & W. at Plainville, remarked.

"No, and if you ask me, it never was," Jim Evans, the roundhouse foreman, replied as he dropped the only portion of his anatomy that wasn't tired in a chair.

"What I mean," Harris explained, "there's more paper work than there used to be; more reports to make out, more correspondence."

"Yes," Evans agreed wearily, "and they run locomotives further and faster and pull bigger loads. Work has to be done better, too. A locomotive patched up with hay wire and half a dozen leaky flues stopped with hickory plugs can't stand the gaff now."

Evans felt in his pocket for a cut of "horseshoe." He eyed the plug reflectively. "A roundhouse foreman makes nearly as many miles a day now as a locomotive did then. Now we start a locomotive out on a 1,600-mile run and if there's a five-minute delay with a hot trailer brass, the roundhouse foreman gets more letters than Charlie McCarthy!" Evans wrenched off a corner of the plug of "horseshoe" and settled himself back in the chair.

The foreman picked up a copy of a railroad shop paper, and began thumbing through it until he came to an article about failures caused by broken pins and rods. The illustration attracted his attention first. Some of the breaks shown were almost identical with ones he had experienced in a recent epidemic of such failures.

Evans propped his feet up on the desk and prepared to read in comfort. He had about half finished the article and was too much interested to notice when H. H. Carter, the master mechanic, came in.

Carter stood several seconds looking at the foreman without saying anything, until the clerk said good morning.

The master mechanic grunted something that was evidently intended as a return of the greeting. Evans looked up with a jerk. The magazine dropped to the floor and the foreman's feet followed closely behind.

"Sorry if I disturbed you," Carter said with a touch of sarcasm. "What you were reading seemed to be very interesting."

"It is," Evans replied. "It's an article about broken pins and rods."

"Well, seems like we've had enough of them around here without reading about the ones on some other railroad." The master mechanic looked at Evans accus-

ingly. "That's one thing I want to talk to you about. The 5077 broke a main pin, you know."

"Yes," the foreman replied, "she's in the house. Tore herself up pretty bad. I had the storekeeper wire for repair parts." Evans picked up the paper as unostentatiously as possible and laid it on the desk.

"Another thing," the master mechanic said, "the superintendent is raising hell about the gas bill. You know ever since we put in gas here the bill has been getting higher each month."

"Yes," Evans replied, "we are using it for a lot of other things besides firing locomotives—heating tires, melting babbitt, heating rivets, and the pipe-fitters use it for heating pipe."

"It's got to be cut down." Carter started to the door. Evans rose and went with him.

The 5081 that had just come in was standing at the engine washing rack. A laborer was washing the working parts of the engine. The master mechanic walked over to see how well the job was being done.

Cleaning the working parts of a locomotive to facilitate inspection and repairing has long been a hobby with Carter. Getting the job done properly has been as perplexing as finding a permanent solution for the relief problem is to Congress.

The laborer was washing the right cross-head and guides and seemed to be doing a pretty good job. The master mechanic walked over a little closer. The pipe and nozzle he was using didn't seem as clumsy and heavy as ones Carter had noticed before.

The official edged nearer for a better look. The laborer turned the nozzle just enough to direct the high pressure spray against the flat surface of the main rod. A pool player would have called it a perfect bank shot; a soldier would have called it a ricochet; what Carter called it wouldn't pass in print. The hot mixture of water, steam, and cleaning compound splashed the master mechanic from head to foot.

Evans strangled on the tobacco juice he swallowed. The laborer pretended he had never seen the master mechanic and kept right on washing the engine.

"Is that a new outfit?" Carter asked after he had mopped himself with a piece of clean waste.

"Not exactly," the foreman replied. "It's part new."

"It's doing a good job. Where did you run across it?"

"In your magazine," Evans told him. "I just happened to be looking through some back issues and found an article on cleaning locomotives. I wanted to try it out before I said anything about it. We've tried so many that didn't work."

"Well, that one seems to do a good job, all right," the master mechanic agreed.

The two men went into the roundhouse, walked through, pausing occasionally to inspect a job or look at some part of a locomotive.

From the roundhouse they went into the machine shop. The wheel lathe operator was turning a pair of driving wheel tires.

"How long does it take to turn a set of tires?" Carter asked.

"Oh, about six pairs a day," the foreman replied.

"That's an hour and twenty minutes to the pair!" Carter exclaimed. "Why, in lots of places they turn out a pair every hour. What's the matter? Can't Jenkins run that wheel lathe?"

"Yes," Evans said, "and he can turn tires as fast as the next one, but sometimes speed is not the only consideration."

"That's all except getting the proper size and shape."

"That's what I thought, too," Evans said, "until I ran across a short article that started me thinking about it. You see, based on a cost of $100, which is approximately what a new tire costs, each sixteenth of an inch of the usable part of a tire is worth around five dollars. When turning tires at high speed, I found that something like a sixteenth of an inch more was taken off than we do now. On a set of eight tires, that's around forty dollars."

"Sounds reasonable," Carter said, "but I never thought of it that way before. I'm going to do a little figuring on it."

The master mechanic went to his office. Evans stayed in the machine shop a few minutes, then went to the roundhouse.

He was still there when the clerk came out looking for him. "The despatcher wants a 5000 for an extra west at 3:15," the clerk said.

"Wonder why he didn't say something about it when I was talking to him about an hour ago," Evans said. "I could have given him the 5082 then. It could have made one more trip before the drivers were dropped. Now she's stripped clean as a bubble dancer. Give him the 5077 and ask him if he can't make it 3:45," the foreman added as he started to the roundhouse to rush the work up on the engine.

Work was progressing fairly well on the 5077. The machinists would be finished by the time the engine could be fired up. The fire builder was told to put a fire in her and get it hot soon as possible.

Starting a fire in the locomotive didn't take long. The boiler was already filled. The fire builder unscrewed a plug in the front end of the oil burner and connected a one-inch pipe that was fastened on to a heavy hose for the gas.

The fire builder yelled a warning, "Look out for a fire on the 5077!"—waited a moment then opened the gas valve. A blazing bunch of oily waste thrown in the firebox before opening the valve ignited the gas and the fire was started.

As Evans watched the fire builder he thought of the days when he was building fires many years ago. Then the S. P. & W. was using coal. When he bedded a firebox down preparatory to starting a fire, he made every scoopful count. Now a fire builder connects up a pipe, lights a wad of waste, throws it in the firebox, and opens a valve. The foreman shook his head. "No wonder gas is wasted," he thought aloud.

Everything seemed to be going about as well as usual in the roundhouse and Evans decided to take advantage of the opportunity to go back to the office and finish reading the article he had started.

Most railroaders that have come up the hard way don't, as a rule, take much stock in technical explanation of cause and result. The idea of a testing engineer using a bunch of gadgets in an office to explain why a main pin broke just naturally goes against the grain. The old adage "he that is convinced against his will is of the same opinion still" holds good in many instances, but Evans is an exception. When he first started following the series of articles about the causes of failures of locomotive parts, he had, figuratively speaking, emitted a raucous raspberry for the writer. The very idea of a tiny tool mark a few thousandths of an inch deep causing a hugh main rod to break seemed ridiculous, until one day he was in the locomotive carpenter's shop.

The carpenter was replacing a broken glass in a wind deflector. The glass used is heavy plate. There was no glass of suitable size available and the carpenter was cutting a piece—breaking would be the more suitable

word. Evans thought as he watched. The carpenter scored the glass by drawing the cutter across it once, then tapped it lightly and it broke sharp and clean where scored.

That, of course, was an exaggerated example as compared with a broken rod, but it started the foreman thinking. From that time he began to examine broken parts more closely in an effort to determine the cause.

Evans may-be hard-headed, but he is honest. In time he became convinced that the testing engineer knew what he was talking about. Other articles in the magazine strengthened his conviction.

The magazine had provided a solution for many perplexing problems. For example, handling driving-boxes with the overhead crane had always been something of a nuisance. One day looking through an issue he saw a short article telling how to build a pair of tongs for handling driving boxes. He had some built and they got the job done.

A jig for machining driving-box hub plates in the boring mill reduced the time required nearly fifty percent, as did a jig for machining boiler-check goose necks, clamps for lifting tires, a better method of chasing threads on washout plugs, and dozens of other ideas that could be used to advantage in roundhouse and shops he found in the magazine.

Evans is about as capable as most railroad foremen. He has had lots of experience but if every one depended entirely on individual experience they would never have time to learn a lot of things they need to know. If every roundhouse or shop foreman could visit every other shop or roundhouse, the chances are something of value would be learned at every place visited. That is an impossibility. The publication which serves his field is the magic carpet that allows the supervisor and officer to visit other places while sitting in an easy chair.

When Evans first started reading the magazine he had the idea that most articles were of a theoretical nature and written by men who had obtained their railroad experience in a parlor car. That was before he became a contributor. Evans had worked out a method for laying out shoes and wedges that is good. Some one suggested that others might be interested in learning the method. Finally he was persuaded to write an article telling how he did it.

Most railroad men are handier with a hammer and chisel than with pen or typewriter. Evans is no exception and his rating as an artist would be preceded by a minus sign.

The clerk typed the article, corrected most of the misspelled words and dropped in a few commas here and there with an occasional semicolon for variety. Evans made some rough sketches that he hoped some one besides himself could understand.

After it was finished, Evans read the article over, looked at the drawings, and pitched the whole thing in the waste basket.

John Harris, the clerk, wasn't going to see all of his work go for nothing. He retrieved the typewritten pages and mailed the whole thing to the editor.

About a month later, Evans picked up a copy of the current issue of the magazine. He was turning the pages when he saw some illustrations that seemed familiar. Then he saw his own name under the title.

"The fellow that made these drawings from what I sent in sure knows his stuff!" Evans held the magazine for the clerk to see.

"Yeah, they look good," Harris said. "The article sounds good, too. I read it," he added.

"Yeah, I guess you must have mailed it," Evans said, trying to pretend that he was annoyed. "But it does make a pretty good article," he admitted.

After that, Evans felt that he had a part in the magazine. He sent in several other ideas for improved methods. Every time one appears in print he is surprised to see how much better they appear than he expected.

Better cleaning of motion work enabled inspectors to detect incipient cracks that would have been unseen before. Failures from broken rods became less frequent. A little more attention to machining pins, together with more rigid inspection when rods were removed, reduced the number of failures from that source. The foreman was congratulating himself over engine performance when he received a letter from the master mechanic.

The letter quoted from one written by the superintendent of motive power. "The amount paid for gas has steadily increased each month," Evans read. "It is entirely too much and must be reduced."

Below was a paragraph dictated by the master mechanic. It was brief and to the point. "In conversation with you some time ago, I pointed out that gas bills at Plainville are too high. You must take immediate action to see that a reduction is made."

"Phew!" Evans whistled, "the gas is getting him hot under the collar. Wonder if he thinks I am a gas combustion engineer!"

The foreman found a water service man. "I want you to go over all the gas lines and see if you can find leaks anywhere. We are using entirely too much gas."

A few leaks, none of them large, were found and corrected. Evans cautioned every one to be careful in the use of gas. The next month's bill was a little lower than the one preceding it, but there wasn't enough reduction to satisfy the officers.

Evans was in his office trying to figure out further reductions in the gas when he noticed a new copy of the magazine. He couldn't resist the temptation to declare a recess from worrying long enough to see what was in it.

The use of natural gas in round houses has materially increased in recent years, but most generally in areas near gas fields where the cost compares favorably with other fuels. As a result, a great deal has not been written on the subject. Evans was agreeably surprised to see an article on gas burners for railway shop use.

He was reading the article when the master mechanic came in. "Well, maybe that explains why we are not making any showing on gas bills," Carter snapped. "The superintendent called me down to the office yesterday and gave me to understand that if the bills weren't cut, he would make it so hot for us we wouldn't need any gas."

"I was just looking at an article—" Evans started to say when the master mechanic interrupted: "To hell with the articles! We've got to do something about it!"

Evans doesn't often get angry, but Carter's attitude aroused his ire. "Well, if you'll tell me what to do, I'll do it!" he said sharply. "What I started to say is I was reading an article about gas burners for railroad use that might help solve our problem."

"Let's see it!" Carter picked up the magazine and glanced at the article. He started to lay the paper down, but a drawing showing a gas burner for starting fires in locomotives attracted his attention.

"If you don't mind, I'd like to look this over," he told Evans.

Burners used in the Plainville shops, except for the ones for heating stationary boilers, are home-made. They had been built with little regard to efficient opera-

tion. If a burner got the job done, it was O. K. regardless of gas consumption.

"What do you say we build a burner like this one for firing locomotives." Carter pointed to the illustration in the magazine. "It might use less gas than firing through the oil burner."

Firing through the oil burner mixes no air with the gas until after it is in the firebox. Air for combustion is drawn in by the blower. The burner shown had provisions for mixing air with the gas.

The burner when completed and tested proved more efficient two ways. Less gas was required to heat a locomotive and it was not necessary to use so much blower. This reduced the amount of steam required from the stationary which in turn reduced gas used there.

New burners of more efficient design were built for use in the pipe-fitter's furnace and for heating tires and rivets.

Two months later one of those rare epistles on a railroad, a letter commending Evans for the reduction in gas, came in the mail.

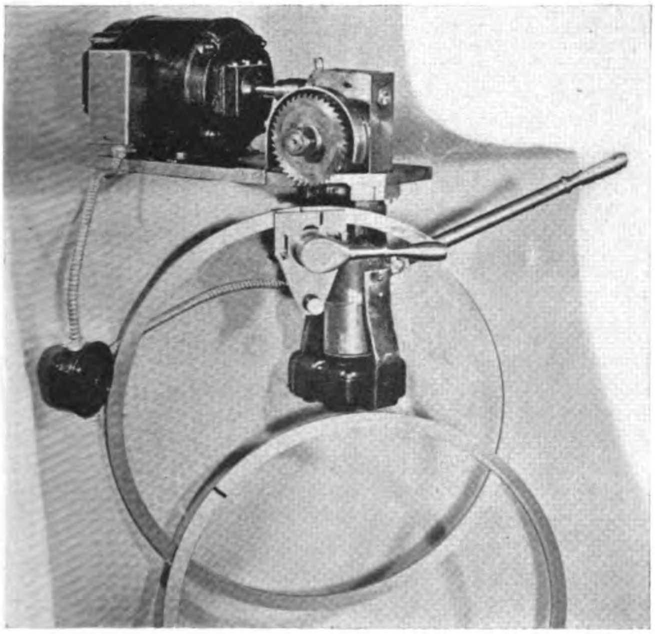
Carter was much relieved and pleased at the reduction. "We've made a better showing than I expected," he admitted.

"Yeah," Evans said dryly, "but we wouldn't if it hadn't been for that article."

"That reminds me," Carter replied. "My chief clerk tells me that you've been getting the copy of that paper that's supposed to come to my office. Hereafter, leave it until I get a chance to read it. If you want to be sure of getting it, maybe you'd better subscribe. I'm going to keep my copy."

Bench Miller for Cutting Piston Rings

In order to cut a section out of piston rings to give them the proper tension, the machine illustrated was developed.



Power miller for cutting ring gaps

This work was formerly done on a Brown & Sharpe milling machine, but so many times when the bench man wanted to cut the rings, the miller was in use. This necessitated waiting for the miller or using a hack saw and filing the ends.

With the bench miller the rings are given one cut and placed in stock. When the piston is to be fitted with rings, they are ordered from stock, marked off in the cylinder and placed in the machine. The saw is driven by a ½-hp. motor. The speed reducer is a worm and worm wheel fitted with anti-friction bearings. The unit is completely enclosed and lubricated by a pressure gun. A flexible coupling is placed between the motor and worm shaft.

The ⅛ in. by 5 in. saw makes 55 r.p.m. The ring is held in a vise the front part of which, when open, falls down on guide pins to allow the ring to be placed in and removed from the vise without any danger of coming in contact with the saw. The vise is attached by welding to a piece of steel tubing which slides in a cast-iron sleeve attached to the plate on which the motor and speed reducer is mounted. The vise with the ring clamped in it is elevated by a handle to engage the saw and make the cut.

As a further safety precaution, a switch is placed so that when the handle is raised to lower the vise, after the cut has been made, it automatically shuts off the power and the motor stops. Any amount of gap between the ring ends can be given without any filing. Provision is also made in the vise to allow any thickness or width of the ring to be cut.

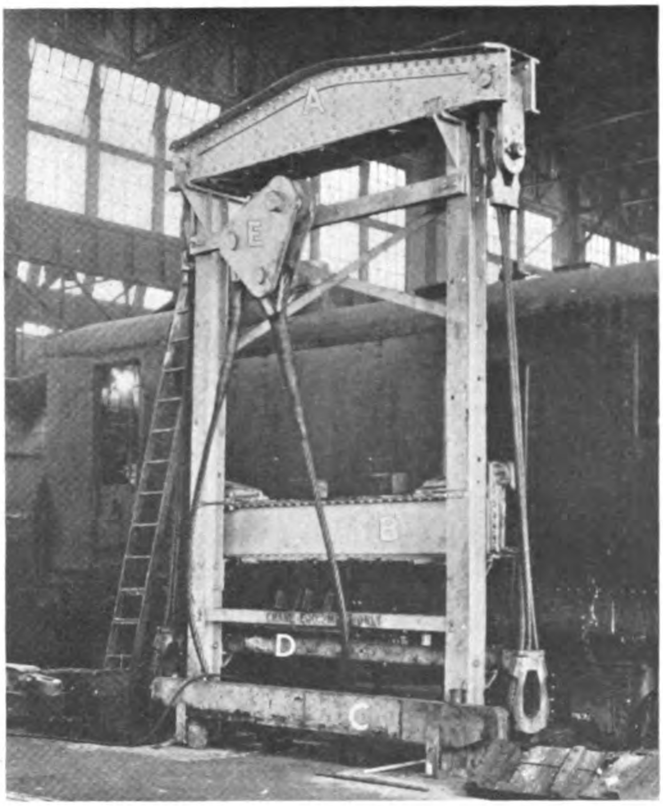
Crane Harness Sling Rack

A compact, efficient and safe rack for holding crane-harness sling equipment when not in use has been installed along with other shop improvements at the Sacramento, Cal., locomotive shops of the Western Pacific.

This rack consists of two 8-in. by 8-in. I-beams about 19 ft. long, spaced 10 ft. apart, and set 3 ft. deep in concrete blocks in the shop floor. A double-bar cross piece, made of 1-in. by 6-in. steel, and two diagonal cross braces, made of 3½-in. angles, serve to tie the vertical I-beams together near the top, 1¾-in. by 4¼-in. T-irons being provided near the bottom for the same purpose. The upper part of each vertical I-beam is equipped with a strong welded bracket, 6 in. wide by 22 in. long and having the outer ends turned up to support safely the heavy cross bar *A* of the crane-harness sling. For the heaviest locomotive lifts, bottom cross bar *B*, which is shown supported on suitable brackets on one side of the rack, is used, being placed under the rear of the locomotive and designed with a heavy hook on each end to engage the opening in the cable sling.

Bottom cross bars are also provided for lighter lifts, bar *C* being used for small locomotives and bar *D* for light equipment, such as ditchers, cranes, etc. The shackle *E*, with attached cable for lifting the front end of the locomotive, is clearly shown in the illustration, also its method of attachment to the rack. The shackle is supported on the two 1-in. by 6-in. cross bars at the angle shown, so that the large crane hook can be inserted and connected to the top pin without manual assistance.

This rack performs a double function in keeping this important crane equipment off the floor where it would take up valuable space and also be more or less detri-



Efficient and safe crane harness sling rack used at the Sacramento, Cal., locomotive shops of the Western Pacific

mental from a safety standpoint. It also supports the slings in such a way that they can be attached to the cranes with minimum delay and lost motion when needed for use.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Computing Tube Sheet Braces

Q.—I believe you should have Mr. Davies print a correction to the next to the last paragraph in the January "Locomotive Boiler Questions and Answers" from which I quote as follows: "The angle of each brace must be ascertained and, if in excess of 15 deg., the area of the brace must be reduced by multiplying the area of the brace by the cosine of the angle that the brace makes with a line drawn at right angles to the area supported."—J. T. P.

A.—In order to clarify the paragraph questioned, the following example is taken:

Assume that a boiler with 225 lb. working pressure has its tube sheet stayed with 1½-in. diameter unwelded brace rods, the area to be supported is so divided that each brace rod supports an area of 55 sq. in.

The stress on each brace rod would then be determined as follows: Cross-sectional area 1½-in. diameter brace rod = 1.7671 sq. in.

The load on each brace would be the boiler pressure multiplied by the area supported, or

$$55 \times 225 = 12{,}375 \text{ lb.}$$

The stress on each brace would be the load divided by the cross-sectional area of the brace rod, or

$$\frac{12{,}375}{1.7671} = 7003 \text{ lb. per. sq. in.}$$

This is the stress on each brace rod not considering the angle of the brace rod.

Assume that one brace rod was at an angle of 25 deg. with a line drawn at right angles to the tube sheet.

Then the effective cross-sectional area of the brace would be reduced by multiplying the area of the brace rod by the cosine of the angle, or

$1.7671 \times .90631 = 1.601$ sq. in. of effective cross-sectional area of 1½-in. brace rod at 25-deg angle.

The stress on the brace rod would then be

$\frac{12{,}375}{1.601} = 7{,}729$ lb. per sq. in., which would be the actual stress on this brace rod.

Capacity of Locomotive Injector

Q.—Can you give an example of an improved method of figuring the capacity of a locomotive injector?—F. A. J.

A.—The William Sellers Company, Philadelphia, Pa., advises: "There are many factors to be considered in determining the capacity of live steam injectors, such as the temperature of the water in the tender, the height of lift or water head and finally the condition of the injector tubes, whether new or in a worn state.

"The best answer to the question would be to refer to the tables of tests of Sellers No. 10½ lifting injector at various steam pressures from 75 to 225 lb. and tank water temperature 65 deg.

"In the first table you will note that the injector delivers 10.7 lb. of water to a pound of steam at 200 lb. steam pressure. Knowing this, it is a simple matter to take the delivery temperature and, by referring to any standard steam table, arrive at a comparatively close answer to the capacity."

Performance of a No. 10-½ Sellers Self-Acting Injector—Lift, 2 Ft.

A—Maximum capacity					
Steam pressure, lb. per sq. in.	75	150	175	200	225
Gallons of water per hr......	2,757	3,719	3,940	4,068	4,068
Temperature of delivered water, deg. F............	128	149	156	164	174
Water fed, per lb. of steam used, lb.	17.2	12.8	11.8	10.7	9.7
B—Minimum Capacity					
Steam pressure, lb. per sq. in.	75	150	175	200	225
Gallons of water, per hr......	1,009	1,470	1,650	1,846	2,072
Temperature of delivered water, deg. F.............	217	255	257	260	269
C—Range					
Steam pressure, lb. per sq. in.	75	150	175	200	225
Minimum capacity in per cent of maximum	36.6	39.5	42	45.3	49.1
Actual range in gallons per hr.	1,748	2,249	2,290	2,222	1,996
Range in per cent of maximum capacity	63.4	60.5	58	54.7	50.9
D—Limiting Temperature of Water Supply					
Steam pressure, lb. per sq. in.	75	150	175	200	225
Highest restarting temperature, deg. F.	128	118	110	104	96
Highest operating temperature, deg. F.	141	132	129	125	119
Highest operating temperature, Class K lifting or non-lifting injector, deg. F.......	150	151	150	147	144

Method of Making Hollow Staybolt Iron

Q.—How is the hole put in the staybolt iron?—G. A. H.

A.—The hole is put in the staybolt iron by drilling or by some process of manufacture. One method of manufacturing hollow staybolt iron is as follows: A steel or iron pipe, full of sand is inserted in the center of a built-up fagot of steel or iron rods, as the case may be, heating the entire fagot to welding temperature and rolling. The elongation of the billet compresses and elongates the core of sand, which is subjected to pressure as well as heat. As a result, when the bar has reached the required diameter, which ranges ordinarily from 7/8 in. to 1 3/16 in., the sand core has a diameter of about 3/16 in. The sand has been very highly compressed and has become as fine as flour. This core is removed by compressed air.

Boiler Plate Embrittlement

Q.—What is boiler plate embrittlement and what causes it?—W. H. D.

A.—Boiler plate embrittlement is a term commonly applied to boiler metal that has failed due to the presence of too high a percentage of caustic soda in proportion to the other solids present in the boiler water.

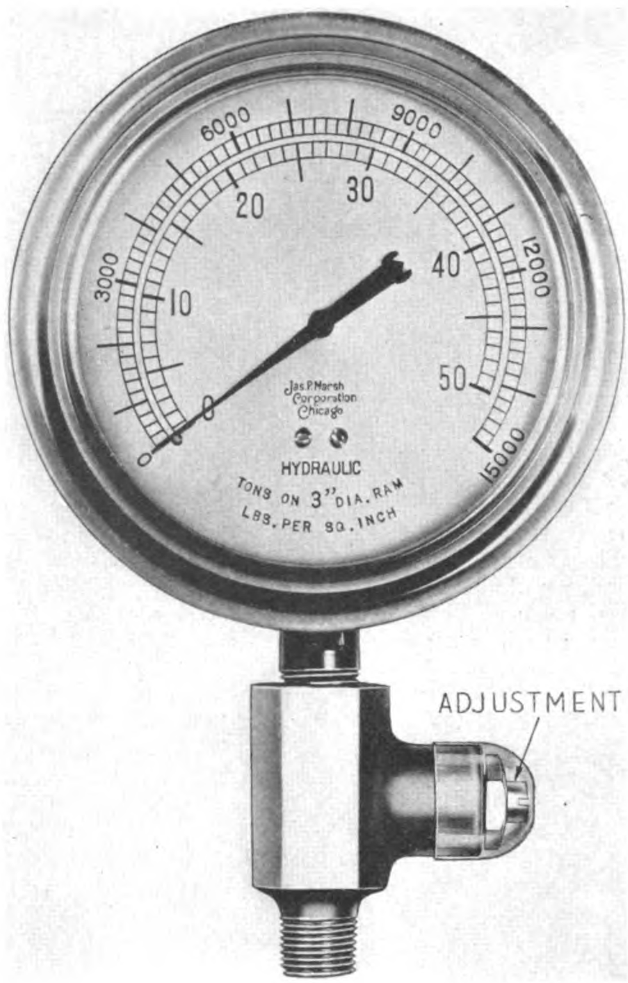
The theory of caustic embrittlement is that caustic soda in percentage of over 35 attacks boiler plate metal which is stressed beyond its yield point. Naturally, boiler waters seldom contain this percentage of caustic soda but boiler seams or the spaces around rivets may become filled with caustic soda and therefore become concentrated to this percentage. It is then in sufficient quantity to attack the metal and cause embrittlement. Actually the boiler metal does not become brittle but is given this term because the cracks caused appear to be due to the metal becoming brittle. Caustic soda evidently attacks the binder between the grains of iron and thereby weakens the structure of the plate.

The most common measure taken to prevent embrittlement is to obtain a proper ratio between the sodium sulphate and the alkalinity content of the boiler water. By increasing the sodium sulphate the percentage of caustic soda as compared to the rest of the solids in the boiler water is reduced, so that when concentrating in the boiler seams, etc., the percentage of caustic soda never becomes of sufficiently high percentage to cause embrittlement. The sodium sulphate seeps into the seams along with the caustic soda and its percentage is higher than the caustic soda. Consequently, the caustic soda percentage never reaches the 35 per cent necessary for embrittlement.

Pulsation Dampener For Gages

The illustrated pulsation dampener for gages, manufactured by the Jas. P. Marsh Corporation, Chicago, is constructed to protect pressure gages from the effects of excessive pulsation in pressure of fluids in hydraulic machinery. It functions to level off the peaks and valleys of oscillating pressure so that the indication hand, instead of vibrating wildly, stands absolutely still or just moves slowly back and forth over a very limited area, indicating the actual true pressure and eliminating the over-shooting and under-shooting which is the case where pressure pulsates rapidly.

This instrument is applicable to all types of hydraulic production equipment such as broaching machines, hydraulic-feed drilling machines, gear cutters, and hydraulic presses. It is also applicable to equipment oper-



The Marsh pulsation dampener for hydraulic gages

ating on air pressure, gas pressure, or on vacua. It is made in two types: the external adjustable type, such as is illustrated, and the internal type which is built into the socket of the gage and which is not adjustable out in the field.

Hydraulic Pipe Bending Machine

(*Continued from page 149*)

bends. The screw to move the nuts and spools is not visible in the picture and is operated from the far side of the machine.

While the nuts and spindle can be locked solidly in any position, the spools are always free to turn. Part of each spool is cut away to allow the pipe to be bent or kinked in any shape; one bend close to another, for example.

The operating valve is placed so that there is no danger of the operator being injured in case a pipe should break. Much time as well as a lot of hard work is saved by the machine and there is but little trouble with flat pipe if the dies are properly made and the spools properly spaced.

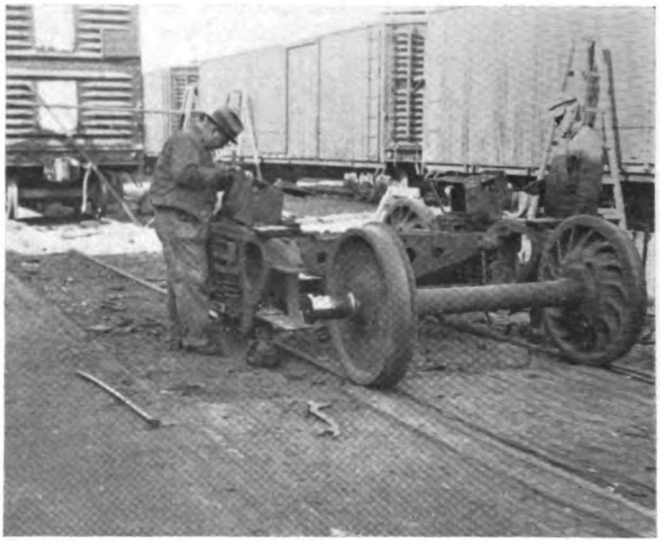
With the Car Foremen and Inspectors

Box Car Repairs With Small Working Force

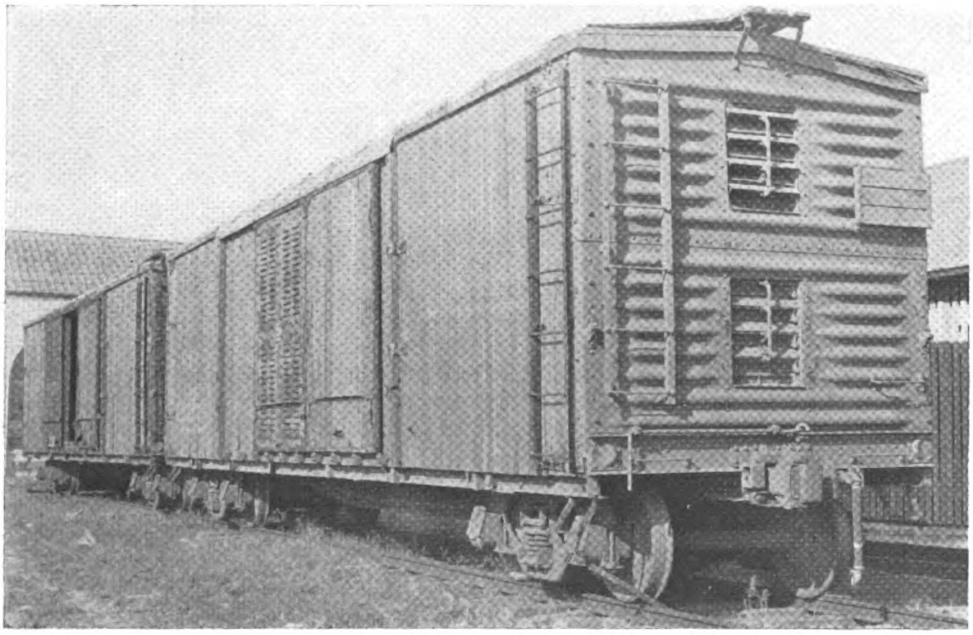
An interesting example of the ability of a small working force to make major repairs to cars is found in the rebuilding of a total of 75 ventilated box cars at the St. Augustine, Fla., shops of the Florida East Coast. These cars were repaired in lots of 25 at a time with a repair force of three car men and three helpers and the output was at the rate of four completed cars in a 22-day month.

After the cars had been placed on the repair tracks at the shops they were stripped down as the condition of each car necessitated. One of the illustrations shows the condition of a typical car after the stripping operation had been finished. The doors and end ventilators had been removed, the interior and exterior sheathing taken off and the old flooring torn up. Likewise, most of the insulation between the inner and outer sheathing was removed. As a rule the structural framing of the cars was found to be in fair condition, necessitating only the replacement of small quantities of corroded material at various locations. The side and center sills required only minor repairs, the heaviest work on these members being the splice-patching of the center sills at the draft-gear location on some of the cars.

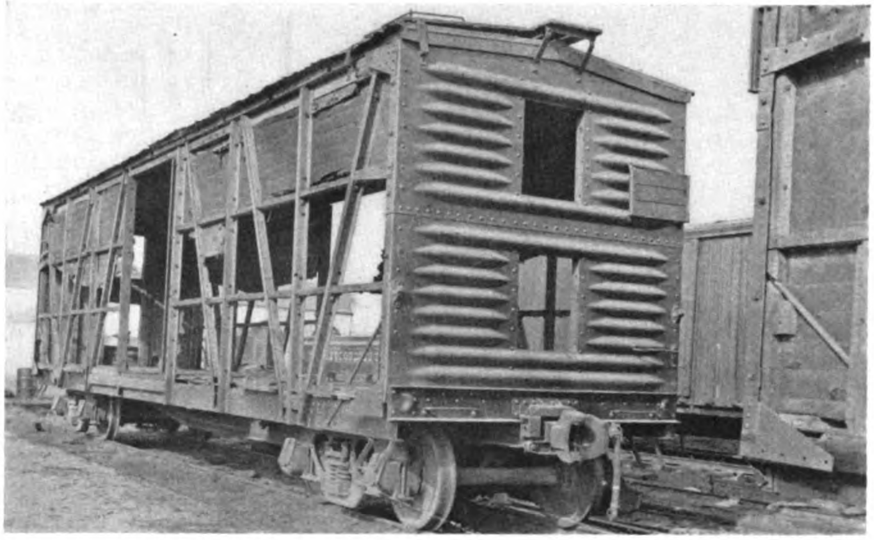
The steel car ends and end sills required somewhat heavier repairs. The car ends were found to be badly corroded just above the end-sill channels. This was repaired by the application of a patch over the entire width of the car. This steel patch was in the form of an angle, the bottom flange of which was secured to the top flange of the end-sill channel and the vertical part of the angle to the bottom of the car end, taking in about half of the lowest corrugation of the steel end. Three of the pictures show the condition of the end sill before repairs were made and after the application of a patch by two different methods—bolting and electric welding. Both methods were used, as circumstances dictated. Where the patch was bolted on it was secured to the end-sill channel by ⅜-in. rivets and to the car end by ⅜-in. Parker-Kalon patch bolts. The patch is made of No. 10-gage steel.



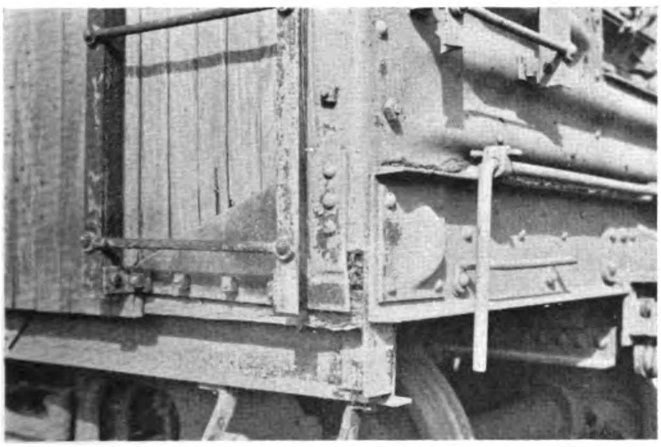
The trucks were completely torn down and all necessary worn parts renewed



Two of the ventilated box cars as they came to the shop for repairs. The ventilator type doors and the end ventilators were removed and replaced with solid doors and the ventilator openings closed up



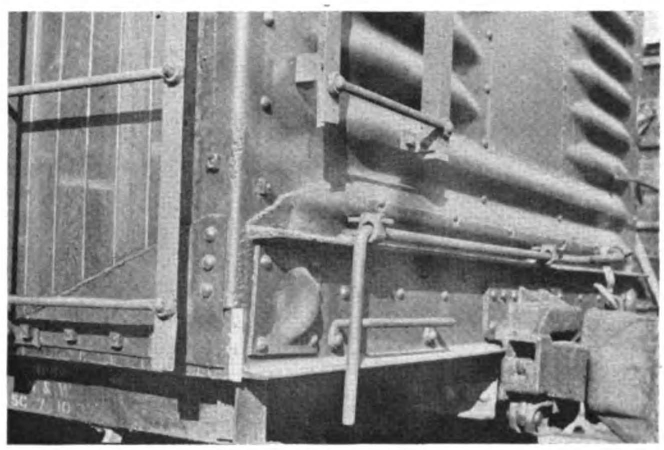
Here is one of the cars at the stage where the stripping has been completed. It is now ready for rebuilding



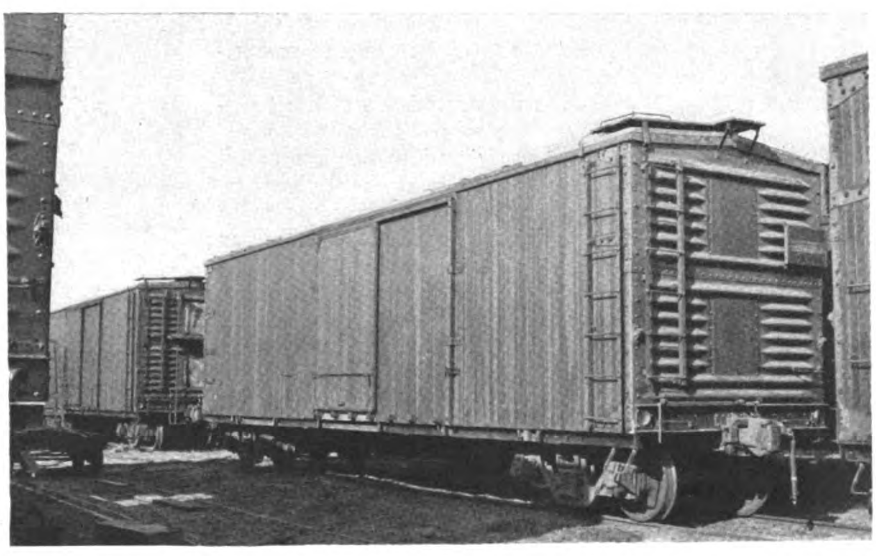
Severe corrosion had taken place at the car ends above the sills

Another job on the car ends was that of closing up the two openings in each end where the ventilators were removed. This was done by the application of No. 10-gage sheet inserts applied over the openings with $\frac{1}{4}$-in. Shakeproof slotted-head patch screws. The patch plate was drilled $\frac{5}{16}$ in. and the car end sheet drilled $\frac{7}{32}$ in. and tapped for the screws. These patch plates were applied with car cement at the joints.

The roofs on these cars were removed, repaired and replaced and new floors and end linings were applied. The sides and top linings were either completely replaced or repaired, depending on the condition of the individual car. The exterior sheathing was completely renewed and the ventilator doors, with which the cars were equipped, were removed and replaced with solid doors. The cinder guards at the front of the doors were replaced



Typical example of end and sill repairs by welding

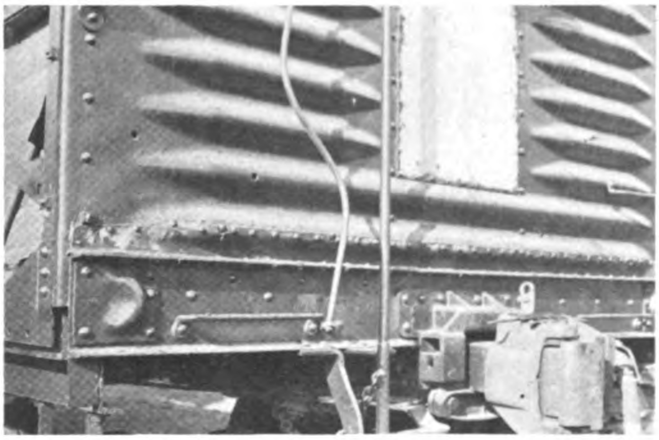


Two of the cars after the general rebuilding work had been completed and the cars made ready for the finish coats of paint

with an interlocking type guard which was made in the shop.

The draft gear with which the cars were equipped was removed and replaced with a Miner A22XB gear and, where couplers required replacing, the Type E coupler was substituted. The brake equipment was completely overhauled and all center plates, side bearings and draft lugs were tightened.

All of the trucks were removed and torn down. These trucks have cast-steel side frames with bolted truck boxes. The wheels are cast iron, 33 in. diameter, and the journals 5 in. by 9 in. New truck parts were applied, where necessary. Cracked side frames were welded. The trucks were reassembled with new dust guards, box bolts and journal brasses.



In this case the patch was applied with patch bolts. The closure of the end ventilators is seen above

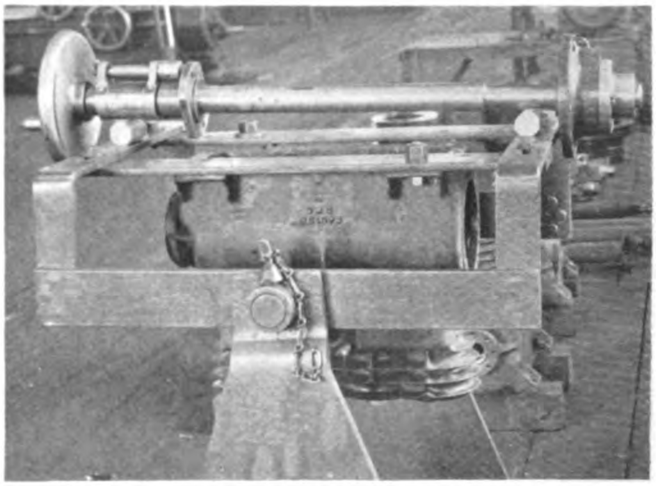
The completed cars were repainted with three coats of red paint on the body, two coats of car cement on the ends and a coat of red on the trucks. After stenciling and testing they were released for service.

Compressor Repair Stand and Boring Bar

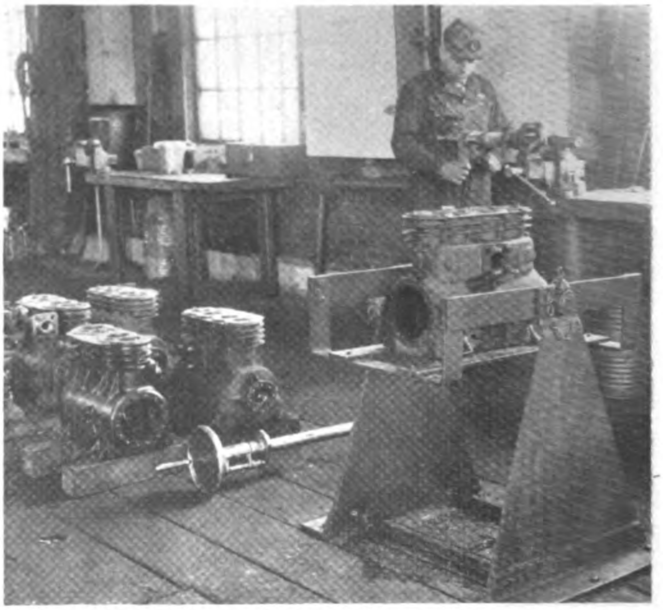
Air-conditioning equipment has now been in service a sufficient length of time on many railroads so that compressors for the refrigerating media, such as Freon, for example, are in need of thorough overhauling, and the accompanying illustrations show two devices which greatly expedite this work at the Union Pacific passenger car shops at Omaha, Neb.

The particular compressors illustrated are of the Frigidaire type. These and other compressors are dismantled, ready for thorough cleaning and inspection of all parts, which are renewed where necessary and reassembled, using the special compressor repair stand shown in the illustrations. This stand consists of two triangular 5/8-in. steel sides, 32 in. high by 24 in. wide at the bottom, spaced 28 in. apart to accommodate the swinging compressor-support frame, and welded to suitable angles which are bolted to the shop floor. The revolving steel framework, which holds the compressor body in either an upright or inverted position by means of a locking pin through the trunnion and bushing connection shown, is 30 in. long by 24 in. wide and supports the base of the compressor 9 in. below the trunnion center. By this construction, it is obvious, therefore, that the compressor body can be readily held in either of two positions, or two elevations, dependent upon which is preferable for the most convenient handling of the various compressor repair operations.

Since a high degree of accuracy is necessary in repairing these compressors to make sure of satisfactory performance, special attention is paid to the crank shaft bearings which are refinished in accurate alinement by the use of the special boring bar shown on the floor in one illustration and on top of the compressor-support stand in the other. This boring bar is designed for use in truing the front main bearing on Frigidaire compressors, which apparently is more subject to wear than the rear bearing. The bar itself is 38 in. long, made of $1\frac{15}{16}$-in. steel, reduced at one end to $1\frac{9}{16}$ in., where it accurately fits in a special bushing bolted to the bell-end of the compressor. At the seal-end of the compressor, another special bushing holds the boring bar in accurate alinement with the original bore of the bearings. The cutter, inserted in a slot in the bar at the main bearing,



Boring bar which is used in retruing the front main bearings of Frigidaire compressors



Air-conditioning compressors receiving general repairs at the Union Pacific passenger car shops, Omaha, Neb.

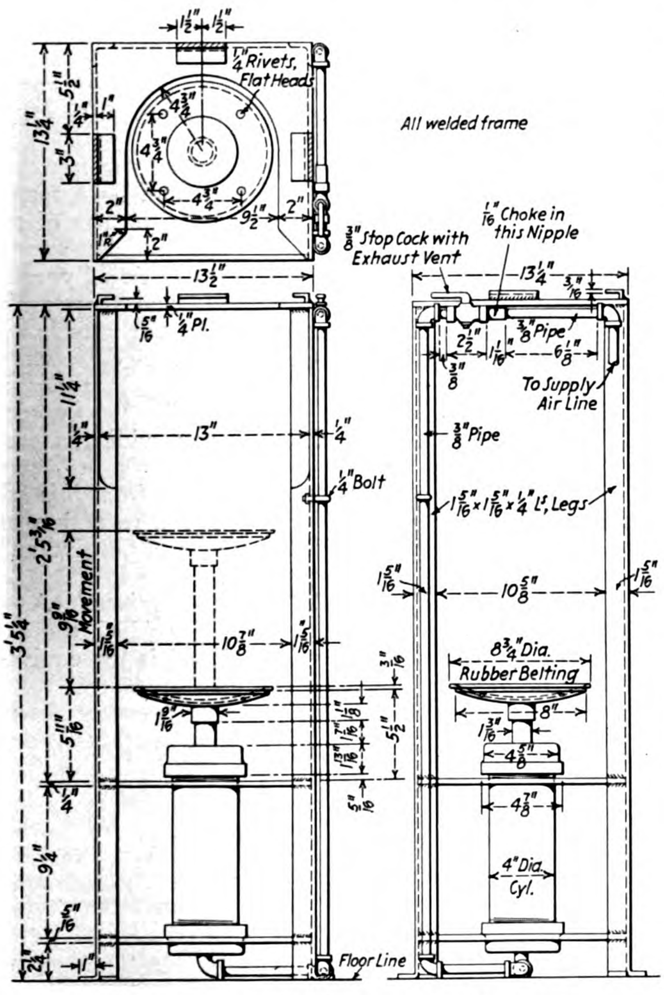
is pin-connected so that when one end is pushed out by releasing one adjusting screw and tightening another, the cutter moves in, and vice versa. In other words, accurate screw adjustment of the 3/16-in. round-nose cutting tool, in and out as desired, is provided. Automatic feed of the cutter is secured by means of a ratchet operated by a dog on the shaft, shown in the illustration, a 9½-in. hand wheel being used to rotate the bar.

This type of boring bar has proved very satisfactory in refinishing the special metal crankshaft bearing in the seal end of the compressor. As many as 30 or 40 bearings may be finished with one grinding of the cutter.

Pneumatic Rack for Compressing Springs

The drawing accompanying this article shows an ingenious design of a pneumatically actuated rack for compressing the spring in the non-pressure head of the AB brake-cylinder piston and non-pressure head assembly. This rack is designed to permit the ready removal of the holder ring and the gradual expansion of the return spring without danger of accident to the operator.

The complete rack is 3 ft. 5¼ in. in height and occupies a floor space of 13½ in. by 13¼ in. A small 4-in. cylinder is located in two spacer plates which are welded to the four corners of the rack. The upper end of the cylinder piston rod is provided with a cup-shaped pusher having an 8¾-in. diameter piece of rubber belting riveted to its top face so as to prevent damaging the piston packing cup on the piston head.



Detailed drawing of rack for compressing springs

When disassembling the piston and non-pressure head assembly, the top face of the non-pressure head engages the under side of the top plate on the rack, this plate being slotted out to receive the tapered projection of the non-pressure head.

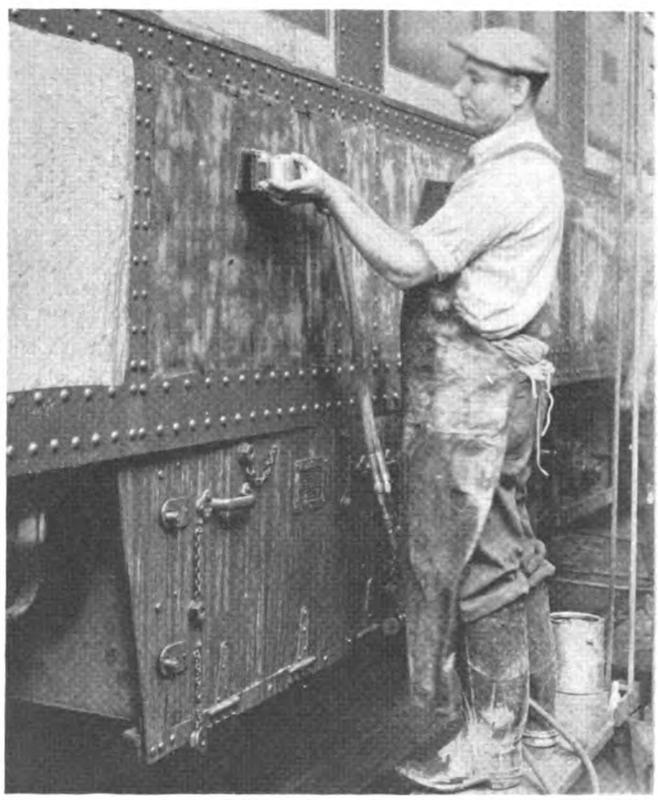
It will be noted that the two front angle irons are cut away 11¼ in. down from the top of the rack to permit the non-pressure head to be swung outward. The upper plate is punched at three points to form three angular clips which face inward and are spaced slightly above the upper deck plate and serve as retainers for the flange of the non-pressure head when the piston assembly is turned upside down for the replacement of packing cups or lubricators.

This device is one that is in use in the shops of the St. Louis-San Francisco.

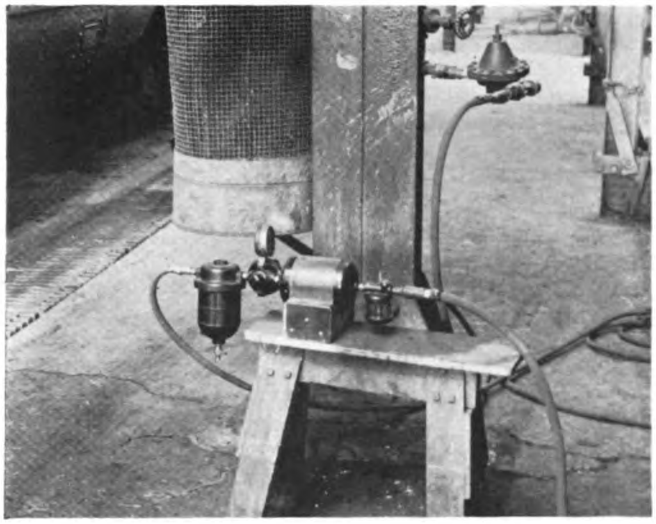
Mechanical Sanding And Rubbing Machine

The illustrations show special equipment used on a western road in water-rubbing the exterior surfacer coat on a chair car. This equipment consists of a Sterling Speed-Bloc sander, or rubber, which is designed with an easy hand hold and convenient operating handle, and has one airhose connection to supply air for vibrating the abrasive rubbing pad, and a second hose connection to supply water necessary in the rubbing operation. The ½-in. hose lines are approximately 50 ft. long so as to reach easily from the center water-and-air supply post to either end of a car.

The necessary shut-off valve and pressure-reducing valve in the water line is shown in the upper part of the second illustration, the water pressure being reduced



Operation of water-rubbing the surfacer coat in a chair car exterior, using a Sterling Speed-Bloc rubber, or sander



Pressure reducing valves and other equipment used in air- and water-lines

from 45 lb. to about 15 lb. Special equipment used in the air line is mounted on a small wooden horse for convenient portability, as shown in the lower part of the same illustration. This equipment consists (left to right) of a water separator, pressure-reducing valve and gage, air strainer and lubricator. The air pressure is reduced from 90 lb. to about 60 lb., which has been shown to give best results with this type of mechanical-sanding machine. The lubricator supplies just enough oil to keep the rubber in good operating condition.

The application of a rubbing surfacer coat with the machine, illustrated, is said to give as good or a better job than would be possible with hand rubbing. It saves about 30 per cent of the manual labor in water-rubbing, or sanding, all flat surfaces.

In this connection, it is interesting to note that the general method of painting car exteriors followed on this road is to remove all paint by sandblasting or some equivalent method and then apply one priming coat, one putty coat, one coat of putty glaze, two surfacer coats and two color coats. The secret of the success of this method of finishing hinges upon the quality of the materials used and the care with which the initial coats are applied. If the putty and surfacer coats are given sufficient time to dry and not hurried too much, a foundation is secured which may be depended upon not to give subsequent trouble.

Among other problems, encountered on this as well as other roads, is the maintenance of satisfactory exterior painting conditions under the highly damaging effect of flying sand and gravel at modern high operating speeds. In some instances this action has been so severe as to cut the paint and actually wear holes in air brake pipe lines under the cars. Special materials, including rubberized paints, paints with an asphalt base, and sand-impregnated paints have been experimented with in an attempt to solve this problem, but so far without entire success.

Air Brake Questions and Answers

D-22-A Passenger Control Valve

410—*Q.—What are the functional characteristics of the brake as applied to passenger trains?* A.—This brake includes the proven desirable elements of its predecessor in this class of service with the addition of features that provide a brake of greater flexibility called for in high-speed operation of modern trains.

411—*Q.—How is a faster and more certain brake action provided?* A.—By features which produce improved functions as will be shown later.

412—*Q.—Is there any improvement in quick service?* A.—Yes. An operation is featured during initial service brake application to insure fast transmission with positive movement of the service slide valve to the application position regardless of service slide valve friction.

413—*Q.—How is the brake cylinder pressure development provided for?* A.—A limited positive and uniform development of brake cylinder pressure results on all cars with a minimum brake pipe reduction.

414—*Q.—How does this affect train slack?* A.—It permits the train slack to adjust promptly without harsh action.

415—*Q.—In what way is service release improved?* A.—Positive release is obtained regardless of service slide valve friction.

416—*Q.—What feature is responsible for this kind of a release?* A.—A release insuring feature which operates to release the brake positively when the brake pipe pressure exceeds the auxiliary reservoir pressure by 1½ lb.

417—*Q.—In what way is the graduated release improved?* A.—The operation of this feature is such that an exceedingly uniform and flexible brake cylinder pressure release is secured on all cars when graduating off the brake.

418—*Q.—Why is an improved emergency transmission speed as obtained with this equipment of great importance?* A.—This is important during emergency brake application due to the fact that a further improvement in control of slack action is accomplished as compared to old standard equipment.

419—*Q.—What improvement is obtained when releasing after an emergency brake application?* A.—A faster and more positive release is obtained by the use of an accelerated release feature.

420—*Q.—How is this accomplished?* A.—By connecting a volume known as the displacement reservoir in addition to the auxiliary reservoir to the brake pipe during initial release to increase brake pipe pressure locally.

421—*Q.—What effect does this have?* A.—Supplements air flow from the brake valve, providing a fast rise in brake pipe pressure.

422—*Q.—What other benefit is derived from this arrangement?* A.—Also provides a definite reduction of auxiliary reservoir pressure thus insuring a positive and prompt release.

423—*Q.—How is increased capacity obtained?* A.—The maximum brake cylinder volume for which the old passenger brake control valve is designed is the equivalent of two 16-in. cylinders. The D-22-A control valve is designed as a piloting device for the operation of one or more large capacity relay valves, therefore, one standard control valve may be used with any desired number, size or arrangement of brake cylinders.

424—*Q.—How are fast application and release rates obtained from high-speed service?* A.—The combination of control valve and relay valve provides exceedingly flexible control of the very fast application and release rates required for high-speed service.

425—*Q.—When mixed with other equipment what provision is made?* A.—The rates of application and release may be adjusted to correspond.

High Spots in

Railway Affairs . . .

Worth Pondering Over

A friend coming from a government office in Washington, recently found himself in a strange street. On a monument to Samuel Gompers in a small park he found this inscription: "No lasting gain has ever come from compulsion; if we seek to force, we but tear apart that which united is invincible. There is no way whereby our labor movement may be assured sustained progress in determining its policies and its plans other than sincere democratic deliberation until a unanimous decision is reached. This may seem a cumbrous, slow method to the impatient, but the impatient are more concerned for immediate triumph than for the education of constructive development."

Highways Being Abused

According to the findings of the research department of the Western Association of Railway Executives, the railways are losing traffic to highway motor trucks that, if carried by the railways, would produce additional annual revenue of nearly two billion dollars. At the meeting of the American Railway Engineering Association, C. E. Johnston, chairman of the Western Association of Railway Executives, said that a recent study in Illinois showed that the state incurred an annual cost of $1,361.28 for a heavy duty truck and collected from the same vehicle only $364.56 in all kinds of fees. Such payments, he insisted, are not taxes, but are merely inadequate contributions towards the enormous expense of providing special facilities (highways) for the special use of trucks. As a matter of fact, such highways, provided at public expense, were constructed primarily for use by passenger automobiles, for farm-to-market service, and the local distribution of goods.

Railroad Legislation

March proved to be a most confusing month, so far as progress toward constructive transportation legislation was concerned. The hearings on the Lea Omnibus Bill continued but the pressure by special interests was so great that the fate of the railroads, as well as the general public interest, seemed to be largely lost sight of. Chairman Lea early in the month introduced the Committee-of-Six Bill in the House, as well as one to place freight forwarders under I. C. C. regulation. The committee hearings included presentations by the waterway interests; a statement from the National Grange; testimony by the trustees of the Chicago Great Western in which, among other things, the policy of the Association of American Railroads was severely criticized; strong objections on the part of the Rock Island interests to features of the Committee-of-Six Bill, including the organization of a transportation board; objections by government traffic clerks to the repeal of the land grant rates; criticism by the trainmen of consolidation features of the Committee-of-Six Bill, etc., etc. Meanwhile the Interstate Commerce Commission gave Representative Lea a lengthy report expressing its opinion on various features of the different bills. "It is always darkest before dawn." reads an old adage. If that is true, then there certainly should be real hope for remedial railroad legislation, because it is hard to conceive of a more confused and complicated situation than that which unfolded itself at the hearings.

Stockholders' Meetings in Britain

Proceedings of the annual meetings of the British railways are always interesting. The shareholders' comments cover a wide range of topics. At the recent meeting of the London & North Eastern Railway Company, for instance, they ranged from the suggestion that a lady director be appointed, to a criticism of the cleanliness of locomotives. One shareholder commented on the fact that "a bright green, clean Pacific locomotive was a joy to the eye and an excellent advertisement to the company." If it is not possible to return to the pre-war standard of cleanliness of locomotives, he suggested that they be painted black to cover deficiencies. Sir Ronald W. Matthews, the chairman, in replying said that "if we economize, as we must economize at the present time, it must mean some deterioration in the condition of our stock." He hoped, however, that it would never be necessary to depart from the green and now the blue engines, which are such a feature of the railway.

If War Comes

Far too little consideration has been given to railway facilities in the discussions of national defense, according to Col. C. D. Young, vice-president of the Pennsylvania, in a recent address before the Ohio Valley Advisory Board in Columbus, Ohio. Colonel Young is chief of the railway section, office of chief of engineers, U. S. Army. He was commissioned a lieutenant-colonel of engineers while engaged in overseas operations during the World War. He advocates the adoption of the recommendations of the Committee-of-Six, if the carriers are to be better prepared for war emergencies. Comparing the equipment today with that of 1929, he believes that "if the railroads were suddenly faced today with a business equal to that of 1929 we might suffer congestion of major importance."

Railroad Wages in 1938

During 1938 employees engaged in maintenance of equipment work to the number of about 240,000, received an average wage of $1,666. This compares with $1,244 for those engaged in maintenance of way work; $1,947 for professional, clerical and general employees; $2,444 for engineers, firemen, conductors and brakemen; and $1,715 for other transportation service employees. The average earnings of all classes of railway employees in 1938 amounted to $1,859, the highest figure ever reached; this in spite of the fact that the average number of hours paid for was 2,481, a considerable decrease from 2,693 in the year 1920. The average hourly earnings, however, were 74.9 cents in 1938, as compared to 66.6 cents in 1929, and 67.6 cents in 1920.

1938 Capital Expenditures

The Association of American Railroads has announced that the capital expenditures for equipment and other improvements to railway property for Class 1 railroads in 1938 amounted to $226,937,000. This was less than half the expenditure for these purposes in 1937. Of special interest to those in the mechanical department is the fact that expenditures for locomotives in 1938 amounted to $39,570,000, as compared to $59,738,000 in the previous year. Freight train car expenditures amounted to $52,814,000, as compared to $212,902,000 in

Capital Expenditures, 1929-1938, inclusive

1929	853,721,000
1930	872 608,000
1931	361,912,000
1932	167,194,000
1933	103,947,000
1934	212,712,000
1935	188,302,000
1936	298,991,000
1937	509,793,000
1938	226,937,000

1937. Only $18,149,000 was paid for passenger train cars in 1938, although $41,491,000 was expended for this purpose in the previous year. Depression years have caused a heavy falling off in capital expenditures by the Class 1 railroads, as indicated in the table above.

Among the Clubs and Associations

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—Meeting 1:30 p. m., April 13, Burlington Station, Omaha, Nebr. Speaker: C. B. Stemple. Subject: Rules 68 to 82.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—Meeting 10 a. m., May 16, Ansley Hotel, Atlanta, Ga. Speaker: L. E. Caldwell, educational director, Electro-Motive Corp., La Grange, Ill. Subject: Diesel Motive Power.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Meeting April 10, La Salle Hotel, Chicago. Speaker: E. J. Hollahan, general car foreman, Illinois Central. Subject: Handling of Passenger Train Cars in Terminal Yards.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—Meeting 8 p. m., April 18, Hotel Mayfair, St. Louis, Mo., preceded by dinner at 6:15. Speaker: J. M. Patterson, general vice-president, Brotherhood Railway Carmen of America. Topic: Vocational Education of Carmen.

NORTHWEST CAR MEN'S ASSOCIATION.—Meeting 8 p. m., April 3, Midway Club, 1931 University avenue, St. Paul, Minn. Speaker: W. J. Patterson, director, Bureau of Safety, Interstate Commerce Commission. Subject: "The Relation of Car Construction and Maintenance to Safety."

NEW ENGLAND RAILROAD CLUB.—Meeting 6:30 p. m., April 11, Hotel Touraine, Boston, Mass. Speaker: R. F. Harrington, foundry superintendent and chief metallurgist, Hunt-Spiller Mfg. Corp. Subject: "Cast-Iron—From Coast Defense Guns to Modern Locomotive and Industrial Castings," with lantern-slide illustrations.

Club Papers

Steam-Electric Locomotive Discussed at N. Y. Railroad Club

New York Railroad Club.—The 5,000-hp. steam-turbo-electric locomotive recently built for the Union Pacific by the General Electric Company, was the chief topic of discussion at the meeting of the New York Railroad Club on March 24. Some 500 railroad and supply-trade men heard H. L. Andrews, vice-president of General Electric, describe the 530,000-lb. giant, after which the speaker answered the questions fired at him in rapid succession from the floor. ¶ During this period it was brought out, among other things, that the locomotive has been in revenue passenger service on the New York Central between Buffalo, N. Y., and Cleveland, Ohio, as a preliminary to regular operation on the Union Pacific; that adequate comparison between the new locomotive and conventional steam and Diesel-electric power cannot be drawn until the steam-electric has been in service under more trying conditions on heavy U. P. trains; and that General Electric may possibly design a pulverized coal-burner of a similar type. A motion picture reel with sound and a series of slides supplemented the discussion. ¶ The entertainment feature of the program consisted of a play entitled "Achmed and His Three Sons," done in an Arabian atmosphere complete with elaborate settings and costumes with incidental music and a cast consisting of employees of the General Electric. In brief the drama was designed to show what happens when the sales, production or design departments of an industrial concern fail to appreciate the need for one another.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

MACHINE SHOP PRACTICE DIVISION.—Erik Aberg, editor, Machinery, 148 Lafayette St., New York.

MATERIALS HANDLING DIVISION.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION.—M. J. Reed, 2 West Forty-fifth street, New York.

FUELS DIVISION.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

ASSOCIATION OF AMERICAN RAILROADS.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.

MECHANICAL DIVISION.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Annual meeting June 28, 29 and 30, at the Commodore Hotel, New York.

PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York. Convention of entire membership June 14-15, Palmer House, Chicago.

MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4468 Oxford avenue, Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, Hotel Mayfair, St. Louis, Mo.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMAN'S ASSOCIATION.—Roy MacLeod, Room 127, G. O. Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of each month, except May, June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—F. T. James, general foreman D. L. & W., Kingsland, N. J.

INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August, September, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately, excepting June in Los Angeles and October in Sacramento.

RAILWAY CLUB OF GREENVILLE.—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—P. A. Bissell, 40 Broad street, Boston, Mass.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, 1255 Old Colony building, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

TRAVELING ENGINEERS' ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

WESTERN RAILWAY CLUB.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

(*Turn to next left-hand page*)

Chilled Car Wheels have always possessed characteristics not found in wheels made from other materials. Today these wheels are better, stronger, and more uniform than ever before. This is owing in part to important metallurgical and design improvements, in part to a Centralized Inspection Service, and in important part to modernized facilities which produce under more accurately controlled conditions.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

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AMCCW

ORGANIZED TO ACHIEVE:
Uniform Specifications
Uniform Inspection
Uniform Product

The London, Midland & Scottish "Coronation Scot" running beside the Diesel-electric "Capitol Limited" of the Baltimore & Ohio near Waring, Md. The English train will be on exhibit at the New York World's Fair after the completion of its tour through eastern United States

NEWS

Enginehouse Construction

The Pennsylvania has awarded a contract to W. F. Trimble & Sons Company, Pittsburgh, Pa., for the construction of an enginehouse at Oil City, Pa.

The Missouri Pacific has awarded a contract to J. S. Alberici, St. Louis, Mo., for the construction of a 20-ft. extension of five enginehouse stalls in the Ewing Avenue enginehouse, St. Louis, Mo. The new stalls will be 120 ft. long. This work is part of an $80,000 improvement program at this point which will include also the paving of the floors with concrete in 15 stalls, the installation of 15 heating units for thawing out the underside of locomotives and the construction of a tool room to serve both the enginehouse and the machine shop. A portion of the work will be done by company forces.

Record in Average Freight-Train Speed Set Up in 1938

A NEW high record in the average speed of freight trains was established by the railroads of the United States in 1938, J. J. Pelley, president of the Association of American Railroads, announced on February 27. This average speed, according to reports for the year which have just become available, was 61 per cent higher than in 1920.

In 1938, the average distance traveled per train per day was 398 miles, compared with 386 miles in 1937 and 247 miles in 1920. This represents the average time required for the movement of all freight trains between terminals, including all delays en route.

"Because of improvements in locomotive and freight car construction," the statement points out, "the number of delays due to mechanical failures has been reduced. Use of locomotive tenders with a greater fuel and water capacity has reduced the number of stops for supplies en route. Length of locomotive runs has been increased. In addition, improvements in roadway, signals, and methods of operation have further expedited the movement of loaded freight cars through terminals and over the road."

Insulating Materials Being Tested at Purdue

THE answers to questions regarding the relative efficiency and effective service life of various insulating materials used in railway equipment are being sought by the Purdue University Engineering Experiment Station in an extensive series of tests being conducted by Prof. W. T. Miller and T. K. Sanders of the Purdue Engineering Experiment Station staff, and M. M. McClure, representing the Gustin-Bacon Manufacturing Company, Kansas City, Mo. The tests are being made in co-operation with the Owens-Corning Fiberglas Corporation, and the Gustin-Bacon Manufacturing Company, and are designed to develop both the mechanical and chemical properties of 38 insulating products under observation.

In developing a method of testing, the Purdue engineers have worked out an eight-hour schedule, which reproduces in that period the conditions that an average car would experience in about 30 days of use on a railroad and, as a result, the insulating materials being tested already have been given the same wear that they would receive in 74 years of actual service. The tests have been under way approximately two years, during which period some of the materials have fallen by the wayside while others have shown that they will stand up under the severe conditions imposed on them.

As one of the steps in the testing, there was designed and built a "weathering room," 8-ft. by 8 ft. by 10 ft. In this room, the samples of insulations are subjected to repeated cycles of high humidity and drying which resemble all the conditions they would get in actual service applications in railway passenger and refrigerator cars. The samples under test rest in wire trays, half of them stationary and the other half subject to a vibration which resembles the most severe condition found in railway equipment.

In another room, known as the "hot box," a complete panel from the side wall of a refrigerator car has been set in, enabling the different materials to be tested for their insulation value, moisture absorption, drying characteristics and durability. There is a complete refrigerating unit in another room, as well as two of the largest electric hot plates ever used for determining thermal conductivities, each 30 in. square, to aid in the complete studies being made by this laboratory.

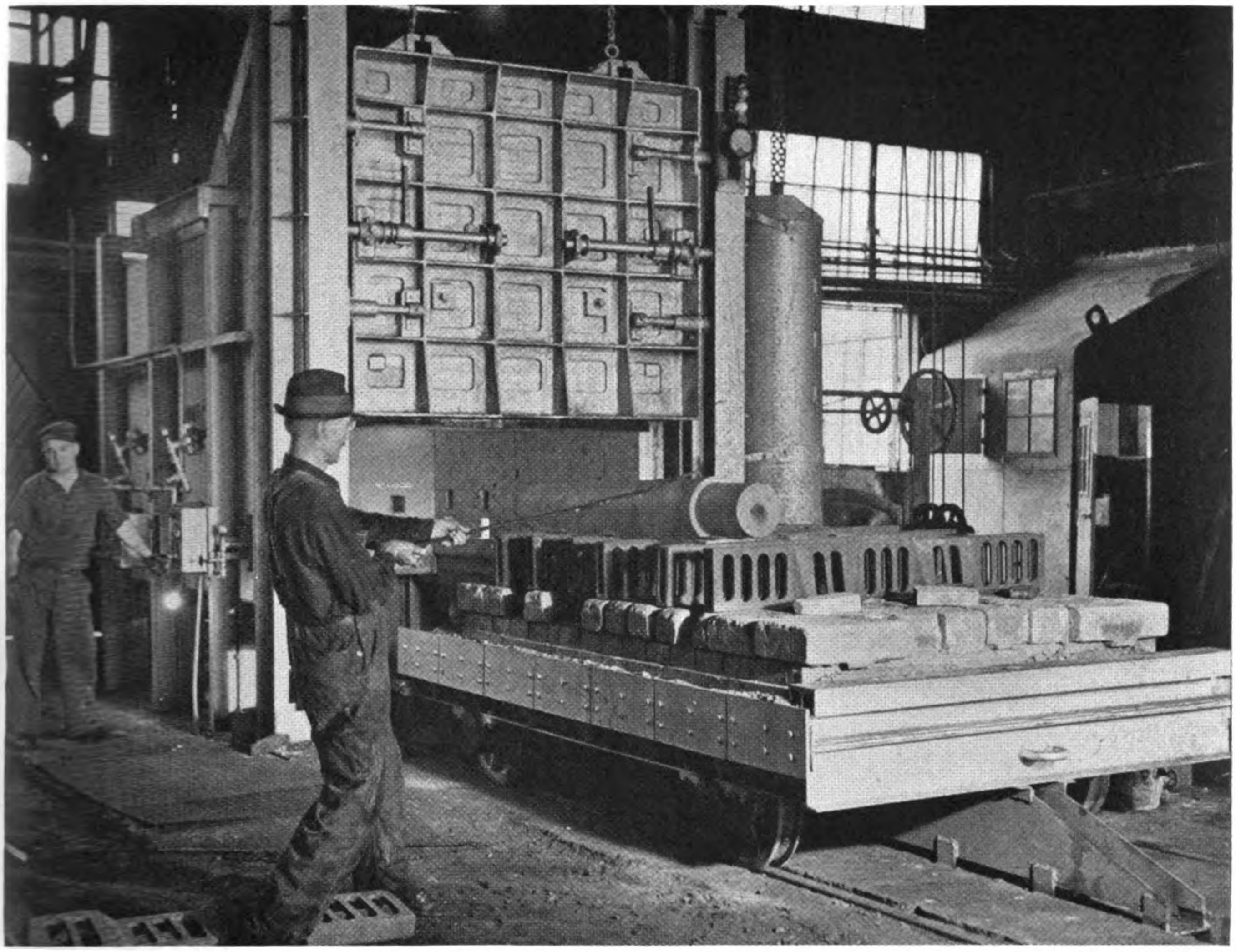
At regular intervals, samples of the various insulation are analyzed chemically and physically to detect any changes in insulating properties. Automatic switches control the testing processes but results must be checked regularly.

Equipment Building in Railroad Shops

The Chicago, Milwaukee, St. Paul & Pacific during 1939 will build in its shops at Milwaukee, 1,000 50-ton all-steel box cars and 75 steel caboose cars. Six Diesel-electric switching locomotives costing

(Continued on next left-hand page)

METHODS AND MACHINERY THAT GUARD LIMA QUALITY



Heat-Treatment Gives Life to Steel

Alloy steels play an ever-increasing part in the modern locomotive.

But only when properly heat-treated can they develop their unusual characteristics of strength and toughness.

At Lima modern furnace equipment provides uniform heating of the part to be treated while pyrometric control insures the precise temperature needed for heat-treating any analysis of steel.

Lima's heat-treating facilities bring out the best in alloy steels.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

in excess of $400,000 will be acquired under a lease purchase plan. These expenditures and other improvements were incorrectly credited to the Illinois Central on page 123 of the March issue of the *Railway Mechanical Engineer.*

The Canadian National will build in its own shops at Transcona, Man., 50 refrigerator cars to have steel underframes, steel superstructures and are to be steel plated. The company will also build 10 caboose cars in its shops at Moncton, N. B., and 15 caboose cars at London, Ont.

New Equipment Orders and Inquiries Announced Since the Closing of the March Issue

LOCOMOTIVE ORDERS

Company	No. of Locos.	Type of Loco.	Builder
C. M. St. P. & P.[1]	2	1,000-hp. Diesel-electric	Electro-Motive Corp.
	2	600 hp.	Electro-Motive Corp.
	2	600-hp.	American Loco. Co.
C. R. I. & P.	11	20-gal. tenders	American Loco. Co.

LOCOMOTIVE INQUIRIES

Company	No. of Locos.	Type of Loco.	Builder
U. S. Navy Dept.	4	Oil burner	....
	1	Fireless	....
	1	Gas-electric	....
	14	40 to 60-ton Diesel electric	....
Wabash	4	600-hp. Diesel electric	....

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Canadian National	725	40-ton box	National Steel Car Co.
	650	40 ton box	Canadian Car & Fdry. Co.,Ltd.
	625	40 ton box	Eastern Car Co., Ltd.
John Morrell & Co.	100	Refrigerator	General American Trans. Co.
Lehigh & New England	100	50 ton hopper	Bethlehem Steel Co.
Lehigh Valley	500	50 ton hopper	Bethlehem Steel Co.
St. Louis Southwestern	100	Underframes for ballast cars	American Car & Foundry Co.
	100	Underframes for flat cars	American Car & Foundry Co.
Union Pacific	300	50 ton flat	Company Shops
	1,500	Underframes	Mt. Vernon Car Mfg. Co.
	500	Underframes	Pacific Car & Fdry. Co.

FREIGHT-CAR INQUIRIES

Road	No. of Cars	Type of Car	Builder
Denver & Rio Grande Western	250	50-ton automobile	....
	250	50-ton box	....
	100	70-ton gondola	....
	100	Underframes for 40-ton stock cars	....
Maine Central	150	50-ton gondola	....
	150	40-ton gondola	....
Swift & Company	2	40-ton tank	....
Wabash	35	Caboose	....

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Canadian National	5	Mail and express	Canadian Car & Fdry. Co.,Ltd.
	10	Baggage	Canadian Car & Fdry. Co.,Ltd.
C. R. I. & P.	2	Rocket trains	See Note[2]
Delaware & Hudson	6	Coaches	American Car & Foundry Co.
Lehigh Valley	10	Coaches	Pullman-Std. Car Mfg. Co.
Southern Pacific[3]	2	14-car trains	Pullman-Std. Car Mfg. Co.

[1] Lease-purchase contracts subject to the approval of the court.

[2] The two streamlined Rocket trains will cost $1,200,000. While formal contracts have not yet been signed, the ten lightweight coaches for these trains, dining cars and head end cars will be built by the Edward G. Budd Manufacturing Company; the six Pullman sleeping cars, including the Pullman observation car, will be built by the Pullman-Standard Car Manufacturing Company; and the two Diesel-electric locomotives will be built by the Electro-Motive Corporation.

[3] The trains will have the same basic design as the present Daylights and will be placed in operation between San Francisco and Los Angeles, Calif., late this year. They will be powered by 5,000-hp. steam locomotives.

Locomotives for Exhibit at New York World's Fair

American Railroads.—The new four-cylinder passenger locomotive, the exhibit of the eastern railways, arrived at the New York World's Fair on March 13 on the tracks of the Long Island and is now installed on its foundation there.

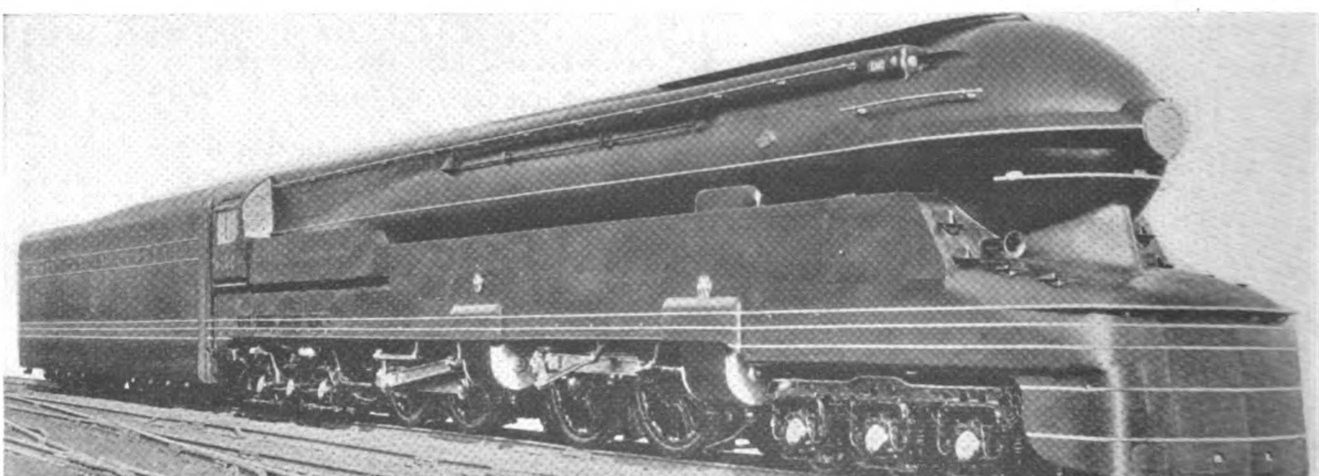
The new locomotive and tender together extend 140 ft. in length and weigh 526 tons. The locomotive, which is non-articulated, has a 6-4-4-6 wheel arrangement and develops 6,500 hp. at 100 m.p.h. Its tender rests upon two 8-wheel trucks and has capacity for 24,500 gal. of water and 25 tons of coal. The locomotive has a tractive force of 76,400 lb.; a boiler surface of 7,748 sq. ft., and operates at a steam pressure of 300 lb. per sq. in. In general style, it is similar to the streamlined "Pacific" type K-4 class passenger locomotive now in operation on the Pennsylvania.

The locomotive was built at the Pennsylvania's Altoona (Pa.) shops and is designed for operation on that road. For the duration of the fair however, it will bear on its tender the signature "American Railroads," and is the exhibit of the World's Fair Committee of the Eastern Presidents' Conference.

Electro-Motive Corporation.—Six days of straining, tugging and delicate engineering were required to haul a two-unit Electro-Motive Diesel-electric locomotive weighing 560,000 lb. a distance of about five city blocks over the "made" ground of the New York World's Fair site between the unloading tracks of the Long Island and a square in front of the General Motors exhibit building where the locomotive is to be displayed. The two units of the locomotive are similar to "A" and "B" units, respectively, of a 6,000-hp., three-unit locomotive placed in service by the Seaboard Air Line in December, 1938. Each unit develops 2,000 hp. from two 1,000-hp. Diesel-electric power plants, as do those of the S. A. L. locomotives, and weight and size characteristics are substantially the same.

Great Northern.—One of America's historic locomotives, the "William Crooks," built at Paterson, N. J., in 1861, and now owned by the Great Northern, has traveled

(*Continued on next left-hand page*)

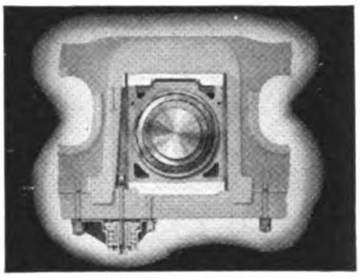


This giant four-cylinder passenger locomotive carries six-wheel leading and trailer trucks and a 16-wheel tender. It has been placed for exhibit at the New York World's Fair by the World's Fair Committee of the Eastern Presidents' Conference Committee. It was built at the Altoona, Pa., shops of the Pennsylvania for operation on that road.

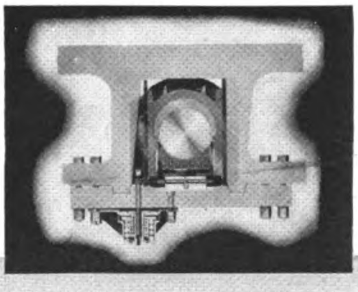
REDUCE MAINTENANCE...

modernize your driving boxes

Pounding driving boxes cause unnecessary expense . . . prevent it . . . by converting your driving box wedges into Franklin Automatic Compensators and Snubbers. » » » The bronze parallel-sided floating plate eliminates the air gap. The heavy outer spring acts as a cushion to take care of abnormal shocks. These insure lower maintenance, easier riding, and increased availability for service on both plain and roller bearing applications. » » » Take advantage of engineering improvements . . . bring your driving box wedges up-to-date . . . convert them into Franklin Automatic Compensators and Snubbers.



ABOVE: Franklin Automatic Compensator and Snubber for Roller Bearing Driving Box application. *BELOW:* Franklin Automatic Compensator and Snubber for Friction Bearing Driving Box application.



Because material and tolerances are just right for the job, genuine Franklin repair parts give maximum service life.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

under its own power from St. Paul, Minn., to New York, where it is to be part of the exhibition, Railroads on Parade, at the New York World's Fair. The locomotive, pulling two ancient coaches, left St. Paul on March 14.

Boston & Maine.—Locomotive No. 905 of the Boston & Maine is being reconditioned at Somerville, Mass., and Billerica, for exhibition at the New York World's Fair. Members of the Railroad Enthusiasts Inc., New England Division, are attempting to make it look as it did in 1892 when it was built at the old Manchester (N. H.) Locomotive Works. Thus the locomotive will bear its original No. 494, an old style headlight, and a wooden pilot and cab, and both engine and tender will be gayly painted.

15-Ton Exhibit Shows How Locomotives Operate

A 15-TON exhibit to demonstrate how a railroad locomotive operates is being prepared for the Museum of Science and Industry, Chicago, by the Chicago & Eastern Illinois at its shops in Danville, Ill. The exhibit consists of a portion of the right side of a passenger locomotive. It includes the pilot, the side frame, the valve chamber, a cylinder, a main rod, a side rod, two driving wheels, and the connecting mechanism. It will be mounted and balanced so that all working parts will be driven by a small motor, while lights will show the movement of steam into the valve chamber and then into the cylinder, which has been cut away to show the piston and connecting rod.

R. R. Equipment to Be Discussed at Automotive Congress

SEVERAL papers of interest to railroaders will be presented at the 1939 World Automotive Engineering Congress of the Society of Automotive Engineers, Inc., which will be held at various points throughout the United States from May 22 to June 8, inclusive. According to the tentative program, two papers of particular application to the railroad field will be presented at the truck, bus and rail car session on May 25 in the Hotel Pennsylvania, New York. Col. E. J. W. Ragsdale of the Edward G. Budd Manufacturing Company will present "Engineering Problems Involved in the Use of Ferrous Metals to Reduce Weight," and Frank Jardine of the Aluminum Company of America will read a paper entitled "Engineering Problems Involved in the Use of Non-Ferrous Metals to Reduce Weight."

On May 26, at the same headquarters, a session on the Diesel engine will be held under the chairmanship of F. G. Shoemaker, Detroit Diesel Engine division, General Motors Corporation, at which time G. L. Neely of the Standard Oil Company of California will read a paper "Recent Developments in Diesel refracting oils." On June 7 at the Hotel Fairmont, San Francisco, Cal., an afternoon session on the Diesel engine will be held under the chairmanship of Mr. Shoemaker, wherein the application of the Diesel engine to railroad transportation will be presented by A. R. Walker, electrical equipment engineer, Illinois Central, Chicago.

N. Y. Central Prepares Rolling-Stock for World's Fair Business

FOR handling heavy passenger traffic for the New York World's Fair, the New York Central will soon put into operation 50 reconditioned coaches and 31 diners, all of which have been newly air-conditioned and improved. Twenty-five of the coaches have been completely redecorated in shades of gray and yellow, with blue upholstery, or tan and ivory with brown upholstery. The floors have been insulated against noise and a new lighting system installed. The 25 other coaches have been redecorated in shades of gray with blue-green upholstered seats and green-striped window curtains. By the air-conditioning of these cars and diners the New York Central's air-conditioned fleet will be brought to a total of 1046.

In addition the road has under construction 40 new light-weight Pullman cars of the type recently installed on the "Twentieth Century Limited" and 11 coaches of the type in service on the "Mercury." These are expected to be in service also for fair travel.

Stoker Order Postponed

THE Interstate Commerce Commission has further postponed the effective date of its order in the automatic stoker case to April 15. The commission's order in this case was upheld by a three-judge federal court at Cleveland, Ohio, on February 28, when it ordered railroads to install automatic stokers on all modern coal-burning locomotives. The order specified that 20 per cent of the locomotives be equipped with automatic stokers each year for five years, beginning July 1, 1938. Approximately 180 railroads had sued to enjoin the Interstate Commerce Commission from enforcing its order of December 27, 1937, contending that the installations would cost $39,003,000 or more. The order applies to practically all locomotives used on main lines. Railroad attorneys are studying the decision and it is quite possible that an appeal will be taken to the Supreme Court.

20 Pullmans at 84 M. P. H.

THE results of a recent test run of the Atlantic Coast Line's steam locomotive No. 1800 between Jacksonville, Fla., and Richmond, Va., are reported in the latest issue of "Baldwin Locomotives," quarterly publication of the Baldwin Locomotive Works. Herein it is revealed that the locomotive, one of 12 Class R-1, 4-8-4 type built by Baldwin, hauled the road's 20-car "Havana Special" along a five-mile stretch at an average speed of 84 m.p.h. At another point the locomotive performed a sprint of 13 miles in length at 73.6 m.p.h. In particular the test run showed decided improvements in acceleration over calculated performance. The test train, which weighed approximately 1,500 tons, attained a speed of 70 m.p.h. in 12.5 min. over a distance of 11 miles. Calculations made prior to the test indicated that nearly 22 min. for a distance of 20 miles would be necessary to attain this speed.

Supply Trade Notes

CHAS. M. GRANNIS and R. J. Perkins have been appointed service engineers of the Carboloy Company, Inc., Detroit, Mich.

◆

THE BUFFALO BRAKE BEAM COMPANY will, on April 12, move its general offices from 92 Liberty street to 140 Cedar street, New York City.

◆

WILLIAM L. STANCLIFFE has been appointed manager of miscellaneous sales for the American Car and Foundry Company, New York.

◆

W. H. KREER, representative for the Middle West for Templeton Kenly & Company, Chicago, has been appointed sales engineer.

LEO F. HUNDERUP, assistant general manager of the Van Norman Machine Tool Company, Springfield, Mass., has been elected a vice-president of the company.

◆

GILBERT E. WEBSTER, has been appointed sales manager of the track spring washer department of the National Lock Washer Company, with headquarters at Newark, N. J.

◆

LEIGH B. BLOCK, assistant vice-president and assistant manager of sales of the flat rolled steel division of the Inland Steel Company, Chicago, has been elected vice-president in charge of purchases, to succeed E. J. Block, deceased.

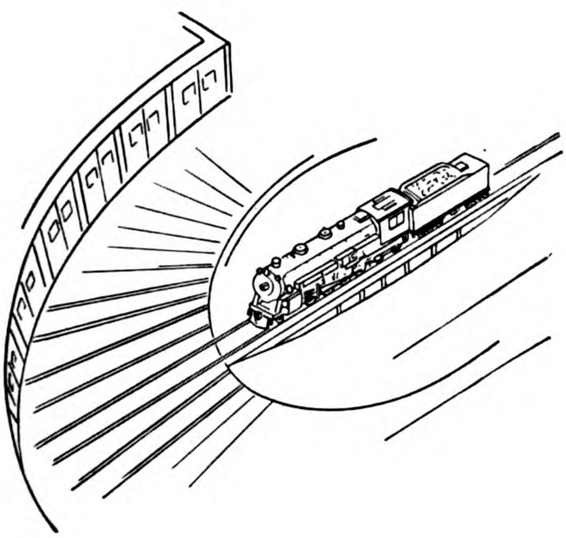
DAVID DASSO has resigned his position as vice-president of the American Locomotive Company, Diesel Engine Division. Mr. Dasso will be retained in a consulting capacity by the Locomotive Company and will also continue in the position of United States representative of Sulzer Brothers, Ltd., Winterthur, Switzerland.

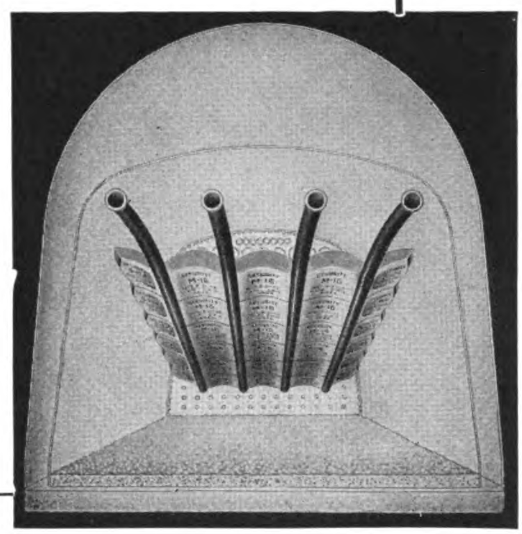
◆

E. K. GOLDSCHMIDT, representative at Philadelphia, Pa., of The Safety Car Heating and Lighting Company, has been transferred to its western district, with headquarters at Chicago, and R. L. Hillpot and Pearce Whetstone have been appointed representatives with headquarters at Philadelphia, Pa.

(*Turn to next left-hand page*)

BE SURE
No Arch Brick Is Missing





There's More to SECURITY ARCHES *Than Just Brick*

In these days of rigid economy, don't draw the line too fine and let a locomotive leave the roundhouse with an imperfect Arch due to lack of supplies.

A single missing Arch Brick has a mighty serious effect on steaming and on the efficiency of the locomotive.

Today, a dollar's worth of fuel means more than ever before. To spend it effectively, every Locomotive Arch should be maintained in perfect condition.

Be sure your stocks on hand are ample to provide fully for all locomotive requirements, so that locomotive efficiency will not suffer.

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.

Locomotive Combustion Specialists

H. A. Marshall, eastern representative, railroad department, of the National Aluminate Corporation, Chicago, with headquarters at New York, has been promoted to assistant to vice-president with the same headquarters.

◆

Ralph F. Heath, representative of Manning, Maxwell & Moore, Inc., at New Orleans, La., has been appointed sales representative at Houston, Tex., and J. Schuyler, for the past five years connected with the company's Los Angeles, Calif., branch office, is now sales representative at New Orleans.

◆

Oliver W. Spencer, sales representative of the Southern Wheel Division of the American Brake Shoe & Foundry Co., at St. Louis, Mo., has been appointed vice-president, with headquarters as formerly at St. Louis. Mr. Spencer entered the

O. W. Spencer

employ of the American Brake Shoe & Foundry Co., in 1923 as a special apprentice at Mahwah, N. J. The following year he was transferred to the sales department at Chicago, and later went to St. Louis as sales representative of the Southern Wheel Company, serving as sales representative until his recent promotion to vice-president, as noted above.

◆

The Unit Truck Corporation, 15 Exchange place, Jersey City, N. J., will, on April 15, open a sales office at 140 Cedar street, New York City.

◆

Charles L. Eggleston, formerly assistant chief car draftsman of the Southern Pacific, with headquarters at San Francisco, Cal., has been appointed special representative of the United States Rubber Company, Mishawaka, Ind., with headquarters at Chicago, to handle the sale of sponge rubber to the railroads.

◆

Malcolm W. Reed, vice-president in charge of operations of the American Steel & Wire Co., has been appointed chief engineer of the Carnegie-Illinois Steel Corporation, to succeed Sydney Dillon, who has been transferred to the office of the chief engineer of the United States Steel Corporation.

J. T. Whiting, who has been elected president of the Alan Wood Steel Company, Conshohocken, Pa., as announced in the March issue of the *Railway Mechanical Engineer,* received his education as a mechanical engineer at the University of Michigan, from which he was graduated in 1909. In July of that year he entered the metallurgical department of the Illinois

J. T. Whiting

Steel Company at its South Works, South Chicago, Ill., and from there went into the blast-furnace department. He has worked successively for the By-Product Coke Corp. (then managed by the Semet-Solvey Co.), South Chicago; the Federal Furnace Co., South Chicago; the Whitaker-Glesner Co., Portsmouth, Ohio; the Steel & Tube Co. of America, Mayville, Wis., and the Donner Steel Co., Buffalo, N. Y. In September, 1927, he became vice-president and general manager of the Hamilton Coke & Iron Co., Hamilton, Ohio, and on January 1, 1932, was elected vice-president of the Alan Wood Steel Company.

C. E. Davis, the newly elected vice-president of the Alan Wood Steel Company,

C. E. Davis

worked successively for the American Sheet & Tin Plate Co., the United Alloy Steel Co., the Central Alloy Steel Company, and the Republic Steel Corporation, before associating with the Alan Wood Steel Company eight years ago. For the past two years he has been assistant to the vice-president. For a year and a half during the World War Mr. Davis was in the U. S. Marine Corps with the A. E. F. in France.

The Acme Machinery Company, Cleveland, Ohio, at a recent meeting elected the following officers: Karl F. Bruch, president; H. N. Anderson, vice-president and general manager; E. P. Bruch, secretary-treasurer. Directors include L. N. Davenport, R. W. Hisey, K. N. Anderson, E. P. Bruch, K. F. Bruch, and D. R. Davies, chairman of the board.

◆

The Hunter Manufacturing Company has moved its office from 25 Broadway to 444 Madison avenue, New York City. The company has appointed, as its distributors of the Rex emergency carbide light in the railroad industry, the following companies: The Rails Company, New York and New Haven, Conn.; Industrial and Railroad Supply Company, 310 South Michigan boulevard, Chicago; The Railway Equipment Company, 757 Paul Brown building, St. Louis, Mo., and Moffett & Romig, Hill building, Washington, D. C.

◆

Chester H. Butterfield, general sales manager of the locomotive equipment division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., has been elected vice-president and general sales manager

C. H. Butterfield

of the industrial and railroad divisions to fill the vacancy caused by the death of W. P. Bradbury. Mr. Butterfield began work with the company in 1917, in the engineering department of the Hancock Valve plant at Boston, Mass. In 1925, he was appointed sales representative of the railroad division in the New England territory, and four year later was appointed assistant works manager at the Hancock Valve plant. In 1931, Mr. Butterfield became sales manager of the Hancock Valve division and, in 1934, was appointed general sales manager of the locomotive equipment division for all products sold to railroads.

◆

A. K. Hohmyer, assistant western manager of the Westinghouse Air Brake Company, at Chicago, has been promoted to western manager, succeeding C. D. Foltz, who has retired after 29 years continuous service. H. H. Burns, mechanical expert for the company at St. Louis, Mo., has retired after 33 years continuous service.

Mr. Burns began his career as a locomotive engineman and as an instructor for the International Correspondence Schools.

He entered the employ of the Westinghouse Air Brake Company in 1906, as assistant instructor on the instruction car and was in full charge from 1909 to 1913, when he became mechanical expert.

Mr. Foltz, before entering the employ of the Westinghouse Air Brake Company in 1910, was connected with the railroad business for many years. Beginning work at the age of 15 years as a telegraph operator, he successively served as fireman, engineman and traveling engineer with various midwestern roads. His positions with the Air Brake Company have been: mechanical expert and representative at Salt Lake City, Utah, and Denver, Colo., assistant western manager at Chicago and then as western manager.

Obituary

CORNELL S. HAWLEY, president of the Consolidated Car-Heating Company, Inc., Albany, N. Y., died on February 26, at his home in Albany, at the age of 70 years.

◆

GEORGE W. WILDIN, former general manager of the New York, New Haven & Hartford and former general manager of the Westinghouse Air Brake Company, died at his home in Pittsburgh, Pa., on February 28, at the age of 69. Mr. Wildin was born in Decatur, Ill., and attended Kansas State Agricultural College (B.S. 1892). Entering railroad service with the Atchison, Topeka & Santa Fe in 1892 as mechanical draftsman, he advanced steadily and, in 1901, became mechanical engineer of the Central of New Jersey. From 1904 to 1907 he was assistant mechanical superintendent and mechanical superintendent of the Erie, becoming assistant superintendent motive power of the Lehigh Valley in 1907. Mr. Wildin was appointed mechanical superintendent of the New York, New Haven & Hartford in 1907; general mechanical superintendent in 1916, and general manager in 1917. The following year he was appointed general manager of the Locomotive Stoker Company, Pittsburgh, and from 1918 to 1926, was general manager of the Westinghouse Air Brake Company, at Wilmerding, Pa. He then served as assistant vice-president of that company and of the Westinghouse Friction Draft Gear Company.

George W. Wildin

Mr. Wildin later was connected with the Cardwell Westinghouse Company. Leaving this organization in 1931, he opened an office in Pittsburgh and retained his connection with the Westinghouse Air Brake Company in a consulting capacity. Mr. Wildin was affiliated with several engineering and railway organizations. He served as president of the former American Railway Master Mechanics' Association from 1909 to 1910, and was a past president of the New York Railroad Club and of the Railway Club of Pittsburgh.

◆

CHARLES A. TERRY, honorary vice-president of the Westinghouse Electric & Manufacturing Co., died on February 18 at his home in New York, after a brief illness, at the age of 80 years. Mr. Terry joined the Westinghouse Electric & Manufacturing Co. in 1888, and served as vice-president from 1909 until April 29, 1931, when he became honorary vice-president.

◆

EMANUEL J. BLOCK, vice-president and a director of the Inland Steel Company, Chicago, died of a heart attack at Phoenix, Ariz., on March 5. Mr. Block was born at Cincinnati, Ohio on May 22, 1880, and since 1901 has been identified with steel manufacturing. In that year he entered the employ of the Inland Steel Company, and during his 38 years service with that company held positions in various departments, including that of assistant secretary and assistant treasurer. For a number of years he had been in charge of the company's purchasing.

Personal Mention

General

FLOYD R. MAYS, general superintendent of equipment of the Illinois Central at Chicago, has been appointed general manager, with the same headquarters.

G. C. CHRISTY, superintendent of motive power of the Illinois Central, has been appointed general superintendent of equipment, with headquarters as before at Chicago, succeeding Floyd R. Mays.

A. B. WILSON, master mechanic of the Coast division of the Southern Pacific at Bayshore, Calif., has been appointed assistant superintendent of motive power, with headquarters at the Sacramento general shops, Sacramento, Cal., a newly created position.

S. M. HOUSTON, master mechanic of the Western division of the Southern Pacific at West Oakland, Calif., has been appointed to fill the newly created position of assistant superintendent of motive power, with headquarters at the Los Angeles general shops, Los Angeles, Calif.

Master Mechanics and Road Foremen

L. T. FIFE, master mechanic of the San Joaquin division of the Southern Pacific at Bakersfield, Cal., has been transferred to the position of master mechanic of the Coast division, with headquarters at Bayshore, Calif., succeeding A. B. Wilson.

R. E. HARRISON has been appointed master mechanic of the Southern Pacific at West Alameda, Calif., succeeding L. A. Mitchell.

E. R. AUTON has been appointed assistant master mechanic of the Southern Pacific, with headquarters at West Oakland, Calif., succeeding E. E. Hinchman.

L. A. MITCHELL has been appointed master mechanic of the Western division of the Southern Pacific, with headquarters at West Oakland, Cal., succeeding S. M. Houston.

R. H. COLEMAN, assistant road foreman of engines of the Logansport division of the Pennsylvania, has been transferred as assistant road foreman of engines to the Ft. Wayne division, with headquarters at Ft. Wayne, Ind.

C. J. SEARS, assistant road foreman of engines of the Ft. Wayne division of the Pennsylvania at Ft. Wayne, Ind., has been transferred as assistant road foreman of engines to the Logansport division with headquarters at Logansport, Ind.

C. S. YOUNG, road foreman of engines on the Missouri Pacific, with headquarters at North Little Rock, Ark., has been promoted to general road foreman of engines, with headquarters at St. Louis, Mo. succeeding E. R. Lockhart, who retired on March 1.

E. HINCHMAN, assistant master mechanic of the Southern Pacific at West Oakland, Calif., has been appointed master mechanic of the San Joaquin division, with headquarters at Bakersfield, Calif., replacing L. T. Fife.

R. E. DETRICK, enginehouse foreman of the Chicago, Rock Island & Pacific at El Reno, Okla., has been promoted to the position of master mechanic, with headquarters at Dalhart, Tex., succeeding C. F. McWilliams, who has been assigned to other duties.

ARTHUR H. FIEDLER, who has been appointed master mechanic of the Fargo division of the Northern Pacific with headquarters at Jamestown, N. Dak., as announced in the February issue, was born on January 24, 1884, at Fargo. He attended high school at Butte, Mont., graduating in 1902. On June 3, 1903, he be-

(*Continued on next left-hand page*)


GM DIESELS—THE MOST ECONOMICAL PRIME MOVER
GM
DIESEL
POWER
LACKAWANNA
READING


New Ways for Old
SAVE MONEY FOR THE RAILROADS
TWO hundred EMC Diesel Switchers now in operation are reducing locomotive costs from 50% to 75%. Availability has averaged 94%. Savings of over $1000.00 per locomotive per month are being obtained—sufficient to liquidate the Diesel's first cost in five years. That's why more and more railroads are swinging to Diesels to reduce operating costs.
ELECTRO-MOTIVE CORPORATION
Subsidiary of General Motors, La Grange, Ill., U. S. A.
GM
DIESEL POWER
LEHIGH VALLEY
ROUTE OF THE BLACK DIAMOND
1103

came storeroom clerk on the Northern Pacific. From September, 1904, until September, 1907, he was a locomotive fireman. From the later date until May, 1934, he

A. H. Fiedler

served as a locomotive engineman, becoming road foreman of engines in May, 1934, and master mechanic in February, 1939.

Shop and Enginehouse

William J. Murphy, foreman boilermaker of the Pennsylvania at Olean, New York, has retired after 50 years' service.

N. J. Whitworth has been appointed night enginehouse foreman of the Atlantic Coast Line at Sanford, Fla.

Lacy W. Register, enginehouse foreman of the Atlantic Coast Line at High Springs, Fla., has retired.

O. T. Elliott, night enginehouse foreman of the Atlantic Coast Line at Emerson shops, Rocky Mount, N. C., has become day enginehouse foreman with the same headquarters.

William McCauley, road foreman of engines of the Monongahela division of the Pennsylvania at Uniontown, Pa., has retired after 52 years' service.

Obituary

C. S. Patton who retired on May 18, 1936, as general superintendent of motive power of the Seaboard Air Line at Norfolk, Va., died in Norfolk on January 13. Mr. Patton was born on April 4, 1871, at Telford, Tenn., and was educated in the schools of that city. He entered railroad service with the Norfolk & Western in September, 1892, at a brakeman. He was later appointed fireman and from February, 1897, to November 20, 1901, he served as an engineman. Mr. Patton entered the service of the Seaboard Air Line as an engineman on the latter date, and in February of the following year he was promoted to road foreman of engines. He became trainmaster in August, 1905, and six years later was appointed master mechanic. In September, 1916, he was promoted to superintendent, and in July, 1918, was appointed superintendent of motive power. On September 6, 1929, he was appointed general superintendent of motive power.

Charles Ellsworth Chambers, who retired as superintendent of motive power and equipment of the Central of New Jersey on October 1, 1933, died on March 20, at his home in Roselle, N. J., after an illness of six months. Mr. Chambers was born on October 18, 1865, at Augusta, Ill., and entered railroad service on July 5, 1885, with the Chicago, Burlington & Quincy, serving first in the bridge and building department and then as fireman and locomotive engineman. From 1901 to 1902 Mr. Chambers was road foreman of engines for the Reading, and from the latter dater until December, 1918, was, successively, general road foreman of engines, master mechanic, general master mechanic, and superintendent of motive power of the Central of New Jersey. Under the United States Railroad Administration, Mr. Chambers served as mechanical assistant to the regional director of the Alleghany region at Philadelphia, Pa. He was appointed superintendent of motive power and equipment of the Central of New Jersey in 1920 and served in that capacity until his retirement. Mr. Chambers was a past president of the New York Railroad Club. He was president of the Master Car Builders' Association from 1916 until 1918, when this

C. E. Chambers

association and the Master Mechanics' Association were merged as a section of the American Railway Association. He then served until 1919 as first chairman of the Mechanical Division.

John Francis Sheahan, former mechanical engineer of the Atlanta, Birmingham & Coast, died in Atlanta, Ga., on February 22. Mr. Sheahan was born on November 21, 1863, at Glyn, Limerick County, Ireland, and attended Franklin Institute, Philadelphia, Pa., and Mechanics Institute, Rochester, N. Y. He entered railroad service in 1880 as an apprentice and machinist on the Pennsylvania and served successively in the mechanical departments of the Camden & Atlantic (Pennsylvania); Buffalo, Rochester & Pittsburgh (Baltimore & Ohio); Orange Belt (now Atlantic Coast Line); Plant system (A. C. L.); Southern; International-Great Northern, and the Georgia & Florida. From 1912 to 1922 Mr. Sheahan was superintendent motive power of the Atlanta, Birmingham & Atlantic (now Atlanta, Birmingham & Coast). In 1923 he was appointed mechanical engineer of the latter road. In 1933, he retired.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Power Jack.—The Duff-Norton Manufacturing Co., Pittsburgh, Pa. Four-page illustrated bulletin descriptive of the new Duff-Norton power jack with the new rotary motor for car and locomotive repair service.

◆

Rolled Steel Structural Sections.—American Iron and Steel Institute, 350 Fifth avenue, New York. Steel Products Manual; price, 15 cents. Definitions and classifications of rolled-steel structural sections of carbon and alloy steels.

◆

"Steel Horizons."—Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. A new bimonthly house organ designed to present timely and factual information both for the fabricator and ultimate user of steel alloys.

◆

Landis Products. — Landis Machine Company, Inc., Waynesboro, Pa. Bulletin No. A-87-1—Landis chaser grinders and chaser grinding fixtures. Bulletin No. F-80-3—Landis line of hardened and ground die heads.

◆

Welding Electrodes and Accessories.—The Lincoln Electric Company, Cleveland, Ohio. 36-page Bulletin 401-A, "Arc Welding Electrodes & Accessories with Procedure for Welding of Various Metals," printed in color.

◆

Wrought Iron Welding; Byers products.—A. M. Byers Company, Pittsburgh, Pa. "The Welding of Wrought Iron," a completely revised bulletin containing practical information for service engineers, also a 56-page catalog of mechanical information on Byers products.

◆

DeVilbiss Hose.—The DeVilbiss Company, Toledo, Ohio. Catalog Hd. Describes DeVilbiss line of hose for all requirements and traces its development from the baled crude rubber, through the factory and testing laboratory to its finished forms.

◆

Fastening Devices.—Parker-Kalon Corporation, 200 Varick street, New York. 68-page, wire-bound catalog-data book. Illustrates and describes the different Parker-Kalon self-tapping screws, explains how and where they are being used, and gives details about other Parker-Kalon fastening devices and specialties.

◆

Metal Hose and Tubing. — Flexible Metal Hose and Tubing Institute, 150 Broadway, New York. 20-page booklet entitled "The Fact Book of Flexible Metal Hose and Tubing," listing and illustrating principal types and forms of flexible metal hose and tubing for the information of design engineers and users.

RAILWAY MECHANICAL ENGINEER

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office.

See page 169

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May, 1939

Volume 113 *No. 5*

Locomotives:

Cars:

General:

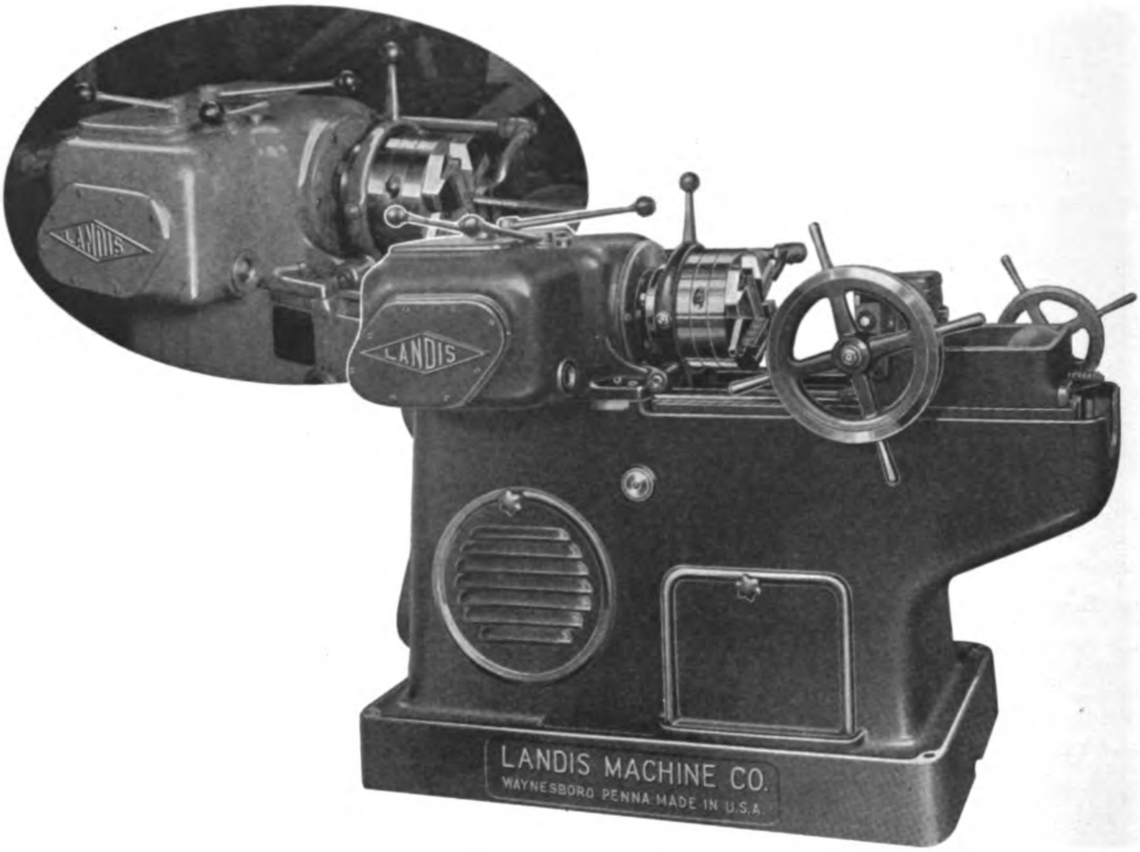
Editorials:

Car Foremen and Inspectors:

Back Shop and Enginehouse:

The LANDMACO Threading Machine

. . . *assures Economy in Railroad Maintenance*



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LANDIS MACHINE COMPANY, Inc.
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C. B. & Q. Installs

"General Pershing" Zephyr

Each passenger car in four-car motor train carries 30-kw. Diesel-electric auxiliary plant for lighting, heating and air conditioning — Non-power trucks are all fitted with disc brakes — Passenger-carrying units are lighted by fluorescent lamps

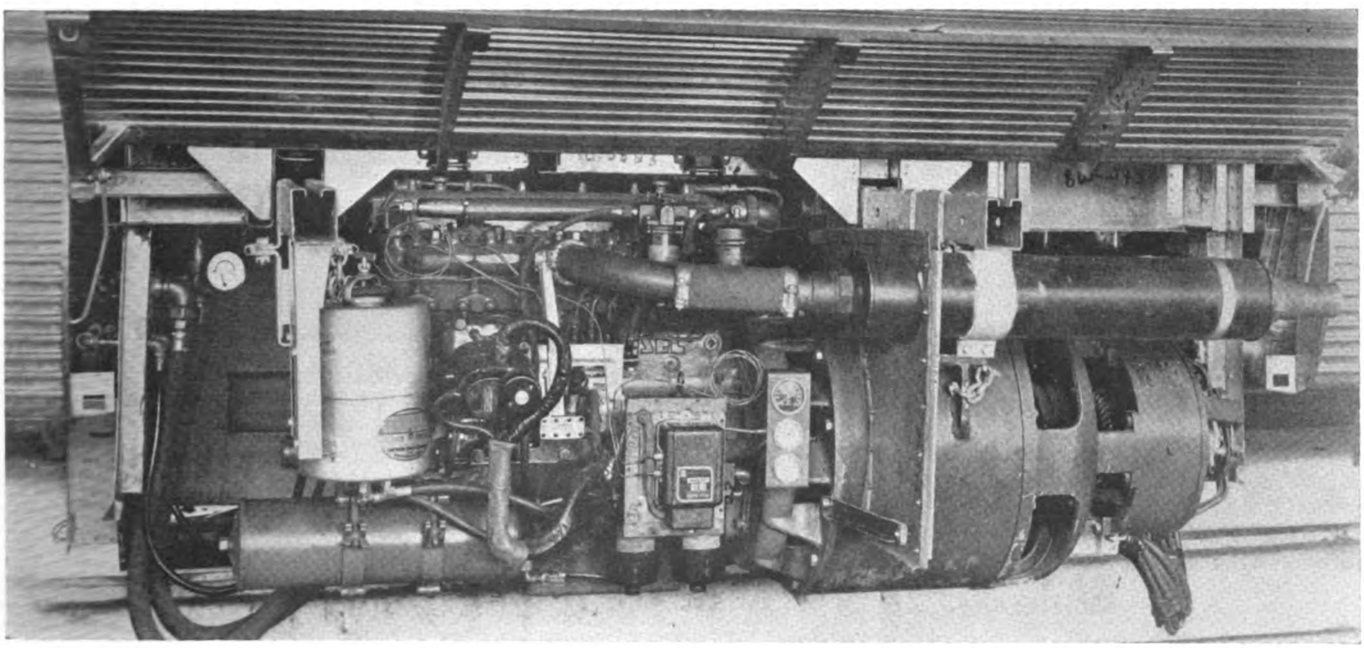
THE complete installation of fluorescent lighting, Diesel-driven auxiliary power plants, and disc type brakes on the trucks characterize each of the passenger-carrying cars on the four-car motor train recently delivered to the Chicago, Burlington & Quincy by the Edward G. Budd Manufacturing Company. This train, of stainless-steel construction, is powered by a 1,000-hp. Electro-Motive Corporation Diesel-electric power plant installed in the front end of the power-baggage car.

The train, which went into service between Kansas City, Mo., and St. Louis on April 30, is christened the "General Pershing," and the name of each of the cars is suggestive of a military career. Thus the power-baggage unit is designated the "Silver Charger" and each of the passenger-carrying cars bears the name of an emblem of military rank. These are, successively, the "Silver Leaf," the "Silver Eagle," and the "Silver Star."

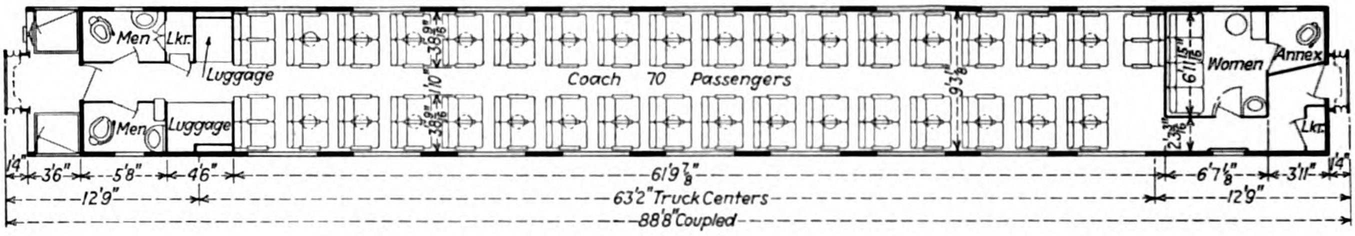
The train provides daylight facilities for 122 coach passengers, with dining service, and a lounge for 22. In front of the engineroom in the first car is a roomy operator's compartment. Back of the engineroom is a 40-ft. baggage room. There are two coaches, the first of which seats 70 passengers, and the second 52 passengers. Each of these cars has a women's lounge, and the second has a men's lounge as well. These cars are vestibuled at one end only. The last car is the diner-lounge. The dining room has three double tables on each side of the aisle, thus seating 24 persons. The dining and parlor-lounge units are separated by the entrance vestibule.

The Car Structures

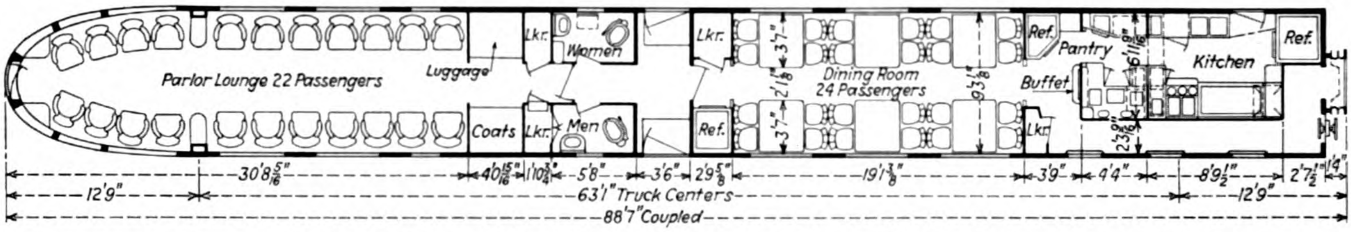
The cars are of Budd stainless-steel construction, the parts of the structure being joined by the Shotweld process. The center sill is built-up of shapes drawn from stainless-steel sheets. It has a cross-sectional area of 12.63 sq. in. The section is symmetrical about both vertical and horizontal center lines, and the line of draft falls on its center of gravity. The rubber draft gears and buffers are of Budd design.



The Diesel-electric power plant which furnishes energy for heating, lighting and air conditioning



The 70-passenger coach has a women's lounge



The lounge-diner—The vestibule is between the dining and parlor lounge sections

In the two passenger cars and in the parlor-lounge there are continuous bag racks of the closed type. The windows are rubber-glazed units with ¼-in. plate glass outside and shatterproof glass in the inside hinged sash. The curved windows in the observation room at the end of the fourth car are double rubber-glazed units. The seats in the coaches are Karpen lightweight, double rotating type, except at the bulkheads where fixed seats are installed. Karpen metal-frame club chairs are used in the lounge and General Fireproofing aluminum-frame chairs in the dining room.

Train Power Supply

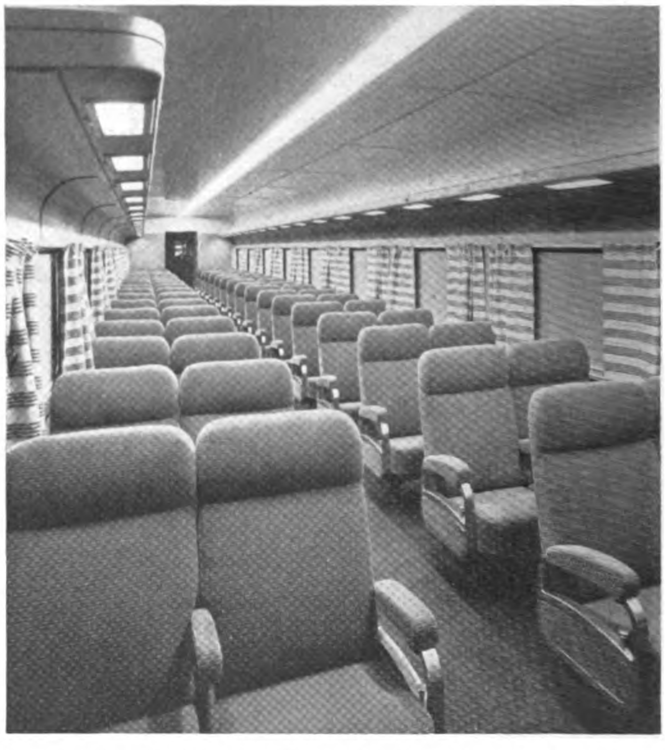
The power plant on each passenger-carrying car—for lighting, air conditioning, and heating—consists of a Hercules 69-hp., six-cylinder Diesel engine, directly connected to a General Electric 1,800-r.p.m., three-phase, 220-volt, 30-kw. electric generator. The operation is regulated by a Minneapolis-Honeywell control system. The power unit is mounted under the car in a sound-deadening inclosure, suspended from a sliding carriage on U. S. Rubber mountings at three points. The engine carriage is mounted on a series of ball-bearing rollers, which permit moving the complete unit laterally from under the car so that all sides of the engine and generator are accessible for maintenance. To roll the unit out of the box it is necessary to take off the side door and remove safety bolts and the exhaust-pipe flange. The fuel-oil, circulating-water and electrical connections to the engine and generator are permanently connected flexible lines. In the event of a power-plant failure, the crippled car may be supplied with power from an adjacent car through a three-wire train line and car connector.

Weights of the Cars in the C. B. & Q. "General Pershing" Zephyr

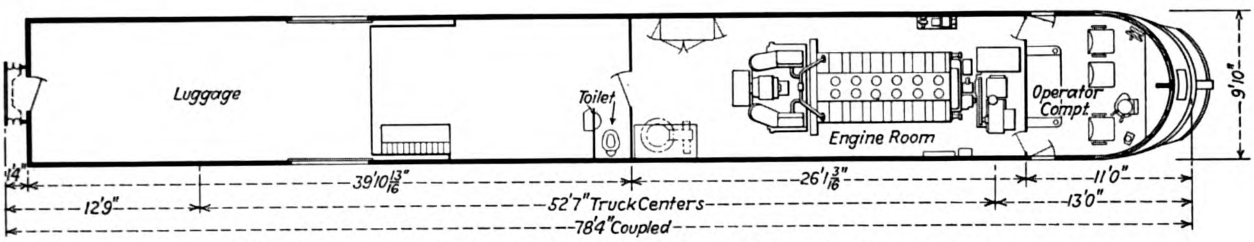
	Body: Dry weight, lb.	Body: Ready for service, lb.	Trucks, lb.	Total ready to run, lb.	Revenue load, lb.
Power-baggage unit	121,945	134,185	67,635	201,820	32,000
70-passenger coach	70,443	73,190	35,210	108,400	11,200
52-passenger coach	67,603	69,790	35,210	105,000	8,320
Diner-lounge	77,523	87,330	36,470	123,800	7,120

Car Heating

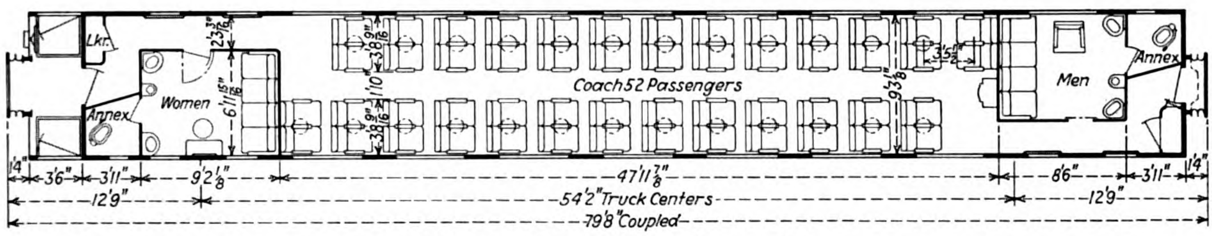
During cold weather the cars are heated by waste heat from the engine jacket water and by electric heaters. The jacket-water heat is distributed through the duct air-distribution system from an overhead radiator, and the electric heaters placed in housings on the floor close to the side walls can be connected in various Y and delta combinations to meet the heating requirements. The individual heating units are so located that there are no hot spots under any connection arrangement. Beginning at 45 deg. F. outside temperature, a small amount of electric heat is used, and this is increased in 5-kw. steps to the maximum. The waste heat from the engine supplies from two-thirds to three-fourths of all the heat required, but cannot be used to the exclusion of the electric heat, since it is necessary to have load on the generator to develop heat in the engine jacket water. The minimum amount of electric heat used is 5-kw. and the maximum is 20-kw.



One of the coaches photographed by the illumination from the fluorescent lamps



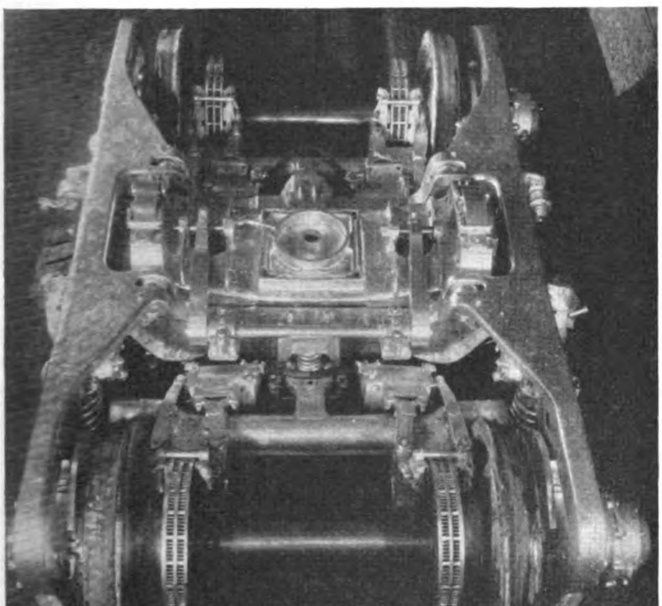
The power-baggage car houses the 1,000-hp. Electro-Motive traction power plant



Lounges are provided in the 52-passenger coach for both men and women

The exhaust gas line from the engine is water-jacketed to the extent necessary to supply the required heat to the cooling water. After the cooling water is discharged from the engine, it passes through a service water heater. There is no storage of hot water, since the service-water heater is instantaneous in action.

From the service-water heater the water passes through a circulating pump and then through an electric immersion heater, which has a three-fold purpose. First, it is used to supply heat to water for standby service in winter. Second, it supplies heat to the car and to the Diesel engine under parking conditions. Third, in cold weather, when the car is being put into service from a cold start, the electric immersion heater is used to warm the Diesel engine sufficiently to make starting easy (50 deg. F.).



Top view of a four-wheel truck showing the disc brake units

Water from the electric immersion heater is piped to a three-way proportioning valve, which is placed so that the total supply of water, or such an amount as is required by the controlling thermostat in the car, may be directed to the overhead radiator in the ventilating duct. The other line from the three-way valve bypasses the radiator and goes into a return line.

The return line is divided, one branch passing to a mixing valve and the other one to Diesel engine radiators under the car, which remove excess heat remaining in the water after that required for car heating or service-water heating has been utilized. The line from the Diesel radiators under the car also passes to the mixing valve, which blends the warm water returning with the cold from the Diesel radiator so that the water always goes to the engine jacket at a fixed temperature of 165 deg. F. the position of the valve is controlled by a bellows thermostat.

The electric immersion heater is an insulated stainless-steel tank containing four 6-kw. heating units. It can be supplied with energy only from a standby source, and is not used when the engine is running.

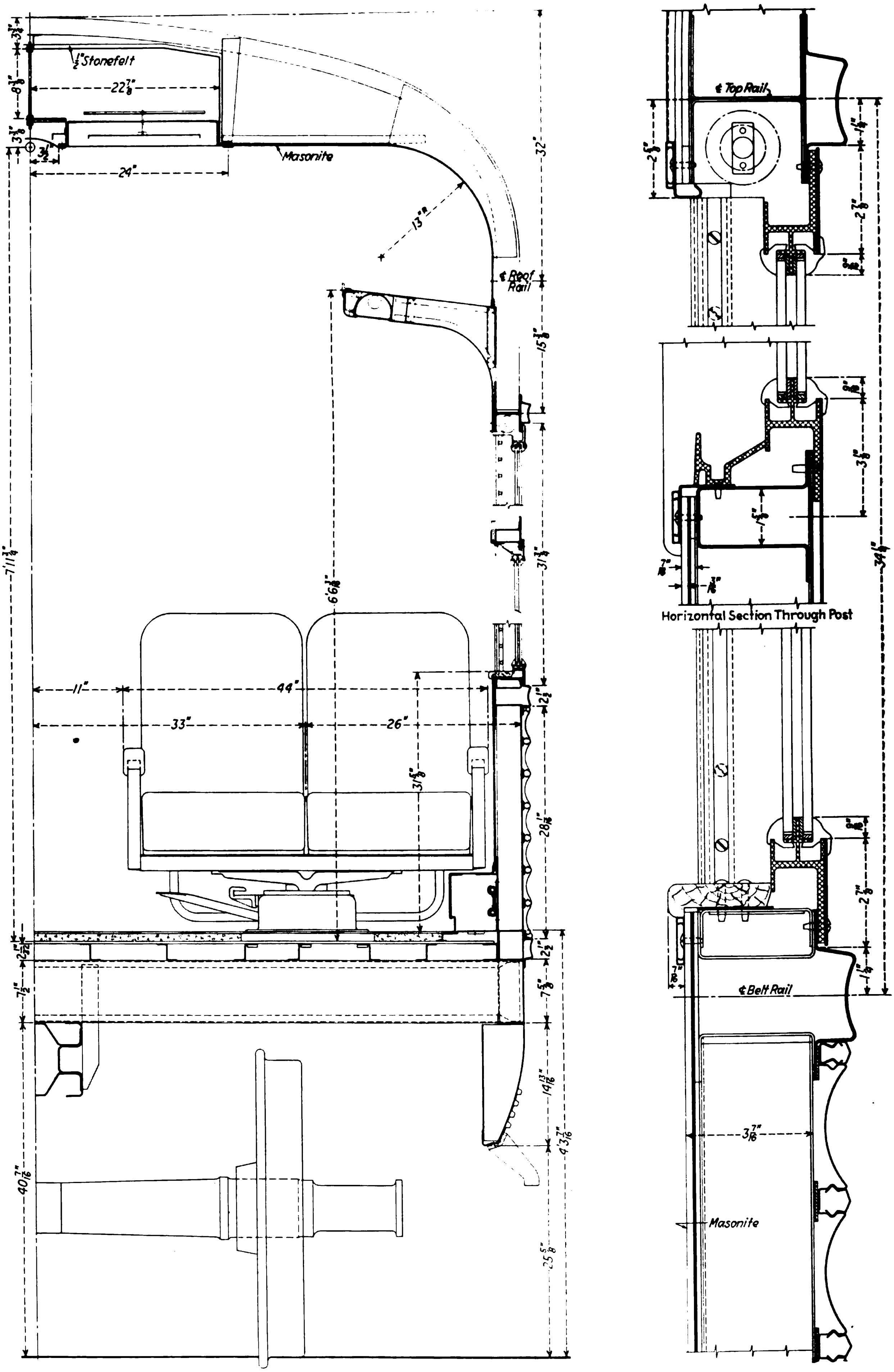
Car Cooling

The G. E. motor-driven compressor which supplies refrigeration does not cycle in the usual manner, but starts automatically when the outside temperature reaches 60 deg. F. and runs continuously as long as the temperature is above that point. At the lower cooling temperature, 75 per cent outside air is admitted through the evaporators and, as the outside temperature rises, the amount of fresh air admitted is reduced automatically from 75 to 25 per cent by dampers in the intake air ducts.

Under these conditions the amount of cooling supplied is in excess of the car requirements, and the air, after being cooled to a low temperature, is reheated to the proper temperature by engine jacket water. This procedure effects maximum dehumidification of the air and minimizes loss of refrigerant caused by starting and stopping of the compressor.

Air sterilization equipment is installed in the path of the recirculating air. It consists of nine 15-watt Westinghouse Sterilamps, which are vacuum tubes made of special glass. They emit ultra-violet light which destroys air-borne bacteria. The Minneapolis-Honeywell temperature-control system maintains an air condition inside the car based on wet-bulb temperature, which is made to vary as a differential of outside temperature.

The air compressor on each of the three cars is a 7½-ton unit, driven by a 10-hp. 3-phase 60-cycle 220-volt a.c. motor. The evaporators in the two coaches



A coach cross-section and enlarged sections through the side walls

each has a capacity of 7½ tons, while the diner-lounge car is equipped with two 4-ton units, one for each half of the car.

Lighting

All of the general lighting and some lighting for special applications is accomplished with G. E. fluorescent units. In the 70-passenger coach a continuous line of 36-in. 30-watt lamps are placed in a shallow circular-arc white reflector extending the entire length of the passenger section. No louvers or other form of light-source protection or control is used.

The center units are supplemented with an 18-in. 15-watt fluorescent unit behind ribbed glass recessed into the baggage racks over each double seat. These can be controlled individually by a small toggle switch at the side of each unit. There is a total of twenty 30-watt and thirty-six 15-watt units, and the illumination on the 33-in. 45-deg. reading plane varies from 20 to 24 foot candles.

In addition to the general lighting, there are 10 blue night lights recessed at even spacings into the center lighting fixture. There are also two 25-watt incandescent vestibule units, four 25-watt incandescent passageway units, two 15-watt fluorescent fixtures in the lavatory, three 15-watt ceiling fixtures, and one dressing table fluorescent lamp in the women's lounge and one 25-watt incandescent unit in the women's annex.

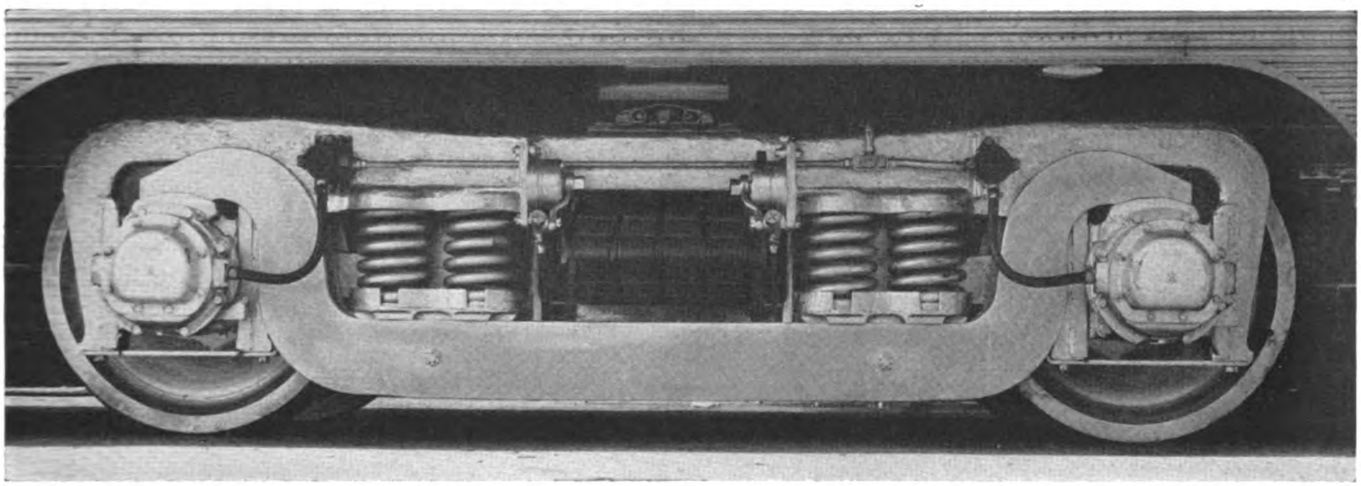
The 52-passenger coach is lighted in a similar manner, except that there are fewer units in the passenger section and more in the lounge. Both the lounge and dining sections of the diner-lounge also have the continuous central lighting fixtures. In the lounge section these are supplemented with 18-in. fluorescent units recessed into the baggage racks, like those in the coaches. There are also continuous built-in coves over the rear windows, in which 18-in. fluorescent lamps are used. In the dining section, the central lighting is supplemented by a 36-in. fluorescent lamp in a cove over each window. This arrangement produces a lighting intensity of 43 foot candles on the table top adjoining the windows and 24 adjoining the aisle. Fluorescent lights are also used over the buffet and in the lavatories. The kitchen, pantry, vestibules, the two marker lights, and the back-up light are all lighted with incandescent lamps.

Auxiliary Electrical Equipment

In addition to the Freon compressor motor, the air-conditioning system employs a Freon-condenser-fan motor, a Diesel circulating-pump motor, a Diesel-radiator-fan motor, an air-duct blower-fan motor, exhaust-fan motors, a damper-control motor, and a three-way-valve-control motor. There is also an air-compressor motor which is used only if the train-line air is not maintained, and compressor and fan motors are required for the water coolers. These create a total power demand of 13.3 kw. The minimum demand for lights is 1.6 kw. and the maximum 4.3. The air sterilization apparatus requires 0.2 kw. The maximum generator load for summer operation is 17.8 kw. and for winter, 30.5 kw. There are also 110-volt outlets in the lounges and lavatories.

Each car is equipped with a Motorola automobile-type radio with two loud speakers. In the coaches the speakers are placed in the front and rear bulkheads of the passenger section, and in the diner-lounge car there is one speaker in each section. An Exide 150-amp. hr. storage battery is used on each car for engine starting and auxiliary-power supply. It is charged from the exciter only.

Wayside power is obtained through 3-pole, 100-amp., 250-volt receptacles, one on each side of the car. A relay locks out the contactor on this circuit when the engine is operating. The electric control for air brake and signals is carried between cars by two 8-point, 20-amp., 250-volt receptacles and jumper assemblies. For train-power emergency connections, there are 3-pole, 200-amp., 250-volt receptacles, two at each end of the car, where such connections may be required. Each car also carries one jumper assembly. To prevent freezing or the formation of rime in drain openings, they are jacketed with thermostatically controlled electric heaters. Electric heaters are also used in the diner-lounge toilets, which are subject to exposure when the car is parked, and there is one heater used in the kitchen to prevent freezing of water. Electric space heaters in the heat-insulated battery box protect the battery from low temperatures.



Decelostats are installed on each axle of all trucks except the power truck

The Brakes

The trucks under the passenger-carrying cars and the rear truck under the power-baggage car are of the four-wheel type with alloy cast-steel frames and bolsters furnished by the General Steel Castings Corporation. These trucks have a 9-ft. wheel base and are of the double equalizer type with helical equalizer springs and elliptic bolster springs. The lateral motion of the bolsters is checked by Houde shock absorbers. All axles of the

four-wheel trucks are fitted with Timken roller bearings. With the exception of the rear power-baggage-car truck and the leading diner-lounge-car truck, which have 6-in. by 11-in. journals, the journals are 5½-in. by 10-in. An unusual feature in the design of these trucks is the use of a torque type lateral stabilizer which prevents the truck bolster from tilting under loads concentrated on one side bearing.

The outstanding feature of the four-wheel truck is

The dining room

the disc brake developed by the Budd Wheel Company. Essentially, this brake consists of a disc and a pair of shoes, one of which bears against each face of the disc. The outer and inner disc faces against which the shoes bear are separated by radial vanes which act as impellers to induce a radial air flow between the inner walls of the braking surfaces, thereby expediting the dissipation of the heat generated in braking.

A disc, with its brake-shoe combination, is mounted against the inside hub face of each wheel. Each segmental brake shoe covers approximately one-third of the disc circumference. The shoes are operated by a pair of tongs fulcrumed on a transverse tubular support, lying just outside of the disc and wheel radius. A brake cylinder is hung on the outer extremity of one of the tongs and the piston rod connected to the other. In this manner the bearing pressure between the two shoes operating on each disc is equalized. The shoes, themselves, are in turn hinged to their respective tongs so that they may aline themselves freely with the disc surfaces.

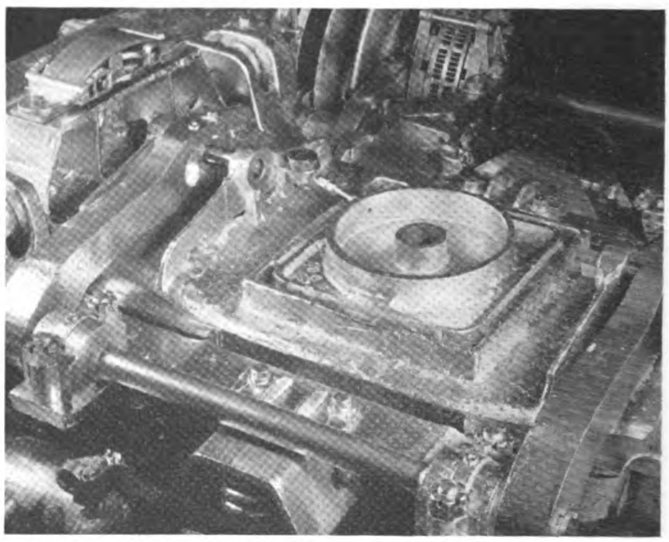
The tubular C-frame upon which the tongs are fulcrumed extends transversely across the truck and beyond the wheels where it is suspended on the journal boxes by integral side arms which reach in radially outside of the wheels. A torque arm on the center of the transverse member of the C-frame is spring supported at the center of the truck transom. The brake cylinders and brake shoes thus have a three-point suspension of essentially the same type as that of a nose-suspended traction motor. The brake shoes, therefore, always remain in fixed radial relation to the axle, and the application of the brakes does not interfere with the full resiliency of the truck suspension.

The wearing faces of the brake shoes comprise a number of segments of automotive type composition lining which are spaced apart and rubber supported on the shoe retainer. This facilitates the maintenance of uniform bearing pressure and improves heat dissipation.

The relatively large surface area on the two sides of each brake disc, combined with the ventilating feature, provides for a high rate of heat dissipation and the maintenance of surface temperatures lower than those developed at the brake-shoe and wheel-rim surfaces with the conventional brake. These factors are expected to effect a more uniform coefficient of friction throughout the duration of brake applications.

The air-brake equipment on this train is the Westinghouse high-speed-control type embodying electro-pneumatic, straight-air and automatic-pneumatic control features. In addition to these regular features of the H. S. C. equipment, this installation embodies the first application of a new means of insuring the highest practicable rate of retardation at all times with protection against wheel sliding. The function is effected by a Decelostat installed on each non-power axle in the train and a Decelostat valve installed at each truck. This equipment operates to check the progress of incipient wheel sliding.

The Decelostat is a rotary inertia device, with its rotor driven through a leaf spring from one end of each axle. The tension of this spring is subject to adjustment. If the axle is decelerated rapidly, as during incipient wheel sliding from a brake application, the inertia of the rotor causes it to tend to overrun the wheel speed, a tendency resisted by the flexing of the leaf spring. As the rotor overruns the wheel speed and, therefore, turns a limited amount on its supporting shaft in the direction of rotation, it closes an electric circuit leading to magnets on the Decelostat valve and on the automatic sanding relay. The valve responds immediately to reduce brake-cylinder pressure quickly through its large capacity relay valve. Coincidentally, the magnets on the electro-pneumatic time-limited sanding system are energized. Sand



The torque stabilizer installation on the four-wheel truck

is thereby ejected on to the rail from the power unit and from the first car for a definite, predetermined interval. When the wheel has resumed its normal speed of rotation by the momentary reduction of brake force, the Decelostat rotor again revolves in synchronism with axle

(*Continued on page 186*)

Association of American Railroads

Passenger Locomotive Tests*

Runs with identical 1,000-ton train on three railroads provide valuable data on high-speed train resistance and drawbar horsepower requirements for operation at 100 m. p. h. on level tangent track

At a meeting of the General Committee of the Mechanical Division of the Association of American Railroads in June, 1938, the Committee on Further Development of the Reciprocating Steam Locomotive presented a progress report. The latter committee was then instructed to prepare plans and was subsequently authorized to conduct a series of road tests to determine the drawbar horsepower required to haul a 1,000-ton train at a constant speed of 100 m.p.h. on level tangent track.

In October, 1938, a 16-car test train was assembled and tests were conducted on the Pennsylvania, the Chicago & North Western, and the Union Pacific. The train, which was assembled by the Pennsylvania from

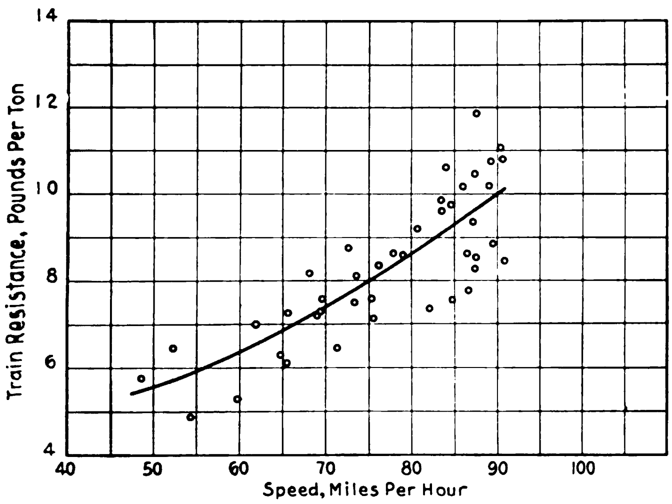


Fig. 1—Train-resistance as determined on the Pennsylvania—Passenger cars with four-wheel trucks—Average weight per car 62.82 tons

its own rolling stock, consisted of 14 P70 coaches, a B60b baggage car, and a dynamometer car. The dynamometer car and the baggage car both had 5½-in. by 10-in. journals and single brake shoes, and the 14 P70 coaches had 5½-in. by 11-in. journals and clasp brakes. All cars were carried on four-wheel trucks. The baggage car weighed 44 tons; the other cars varied from 63 to 64.85 tons; the total weight of the train was 1,005.2 tons, and the average weight per car was 62.82 tons.

Six different locomotives were used on the round trip from Fort Wayne, Ind., to Grand Island, Neb. On the Pennsylvania, the locomotives used were Class K4s Pacifics; on the C. & N. W., Class E4 4-6-4 type built during 1938, and on the Union Pacific, Class FEF1, 4-8-4 type, built in 1937.

The test train was operated through Indiana, Illinois, Iowa, and part of Nebraska, and the total miles run, eastbound and westbound, was 1,560. In the first three named states the gradient was rolling, while in Nebraska there was a continuous ascending grade westbound. The maximum grade on any railroad was 1.25 per cent. The rail weight on the Pennsylvania was 131 lb. per yd., and on the other railroads, in general, 100 lb. per yd. A short stretch of the Union Pacific was laid with 110-lb. rail. The ballast on the Pennsylvania was crushed limestone; on the Chicago & North Western, cinder, gravel, stone, and crushed rod. On the Union Pacific, the ballast was gravel from Sherman, Wyo. A few miles were ballasted with sand, cinders, or slag.

A report of the results of the tests follows:

Train Resistance on Level Tangent Track

Over several stretches during each of the test runs the train resistance was carefully computed from the dynamometer car records and corrected for grade and acceleration, to determine the train resistance in pounds per ton, on level tangent track.

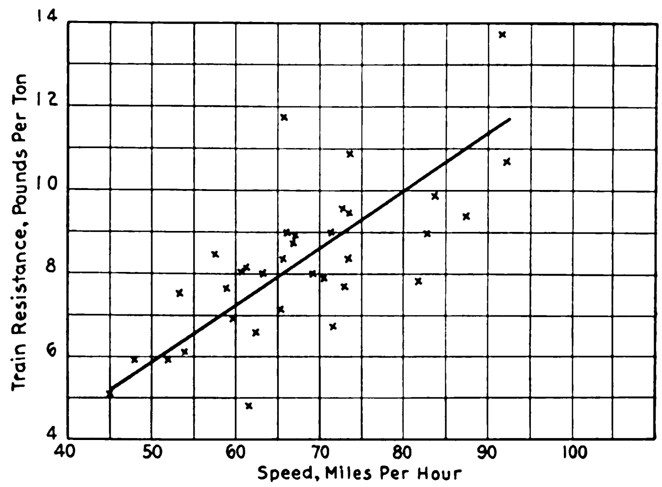


Fig. 2—The train-resistance measurements on the Chicago & North Western—Passenger cars with four-wheel trucks—Average weight per car 62.82 tons

The resistance in pounds per ton, over the test stretches, has been plotted separately for each railroad on Figs. 1, 2 and 3, and average curves have been drawn through the points.

In Fig. 4 the resistance curves for each railroad are shown, together with a curve based on the Davis formula. Although the identical train with the same dynamometer car and crew was used on all three railroads, the resistance varied considerably, and the only explanation may be the difference in track structure.

The tests were run in moderately warm weather, with low wind velocity, and, therefore, any resistance curve

* Abstract of the report of the A. A. R. Passenger Locomotive Tests, October, 1938, issued by the office of the Mechanical Engineer of the Mechanical Division, February, 1939.

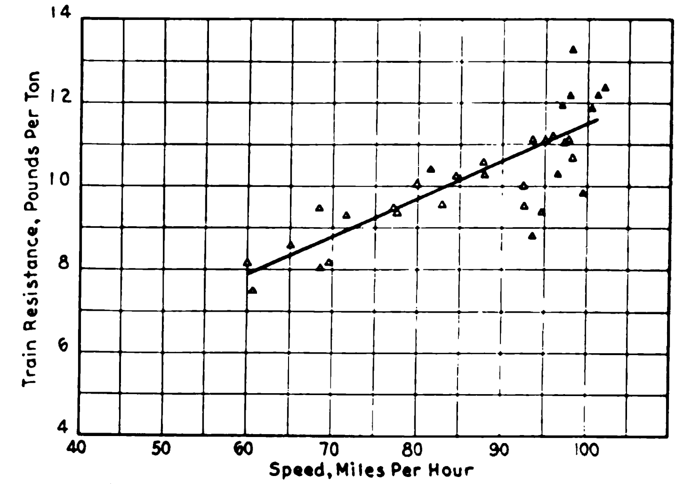
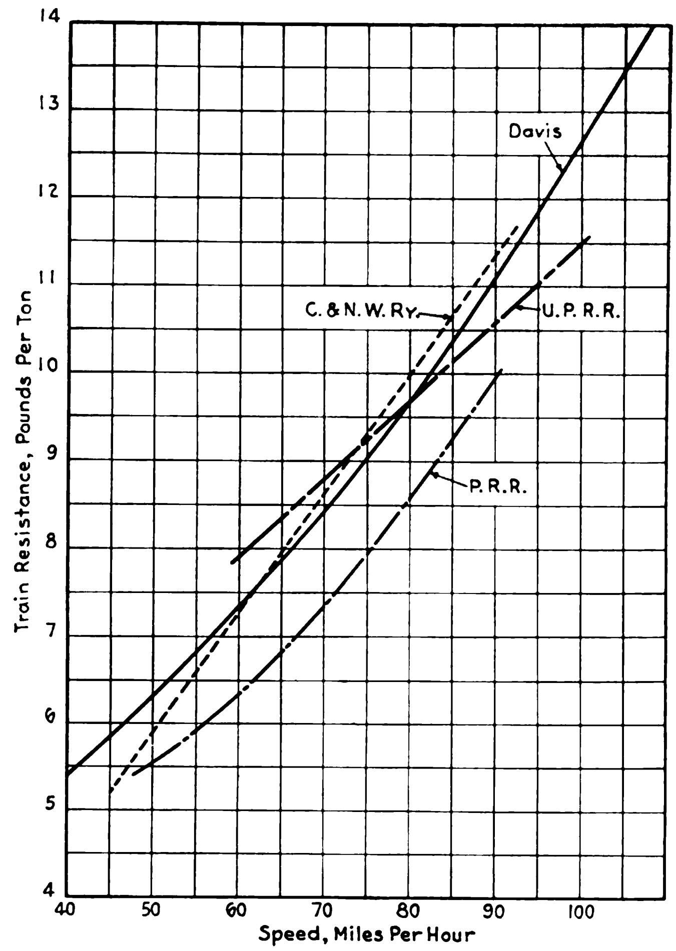


Fig. 3—The Union Pacific train-resistance curve—Passenger cars with four-wheel trucks—Average weight per car 62.82 tons



Davis Formula

$$R = 1.3 + \frac{29}{w} + 0.03V + \frac{0.041V^2}{wn}$$

R = Resistance in pounds per ton
n = Number of axles per car
w = Weight per axle in tons
V = Speed in miles per hour

Fig. 4—The three train-resistance curves compared with the Davis Curve

that is to be used by the designer or operating officer should be selected with due regard for weather conditions. With this consideration in mind, the curve based on the Davis formula is as representative of the test data as any other that could be drawn.

Maximum Drawbar Horsepower

While the tests were run primarily to determine the train resistance at high speeds, the maximum drawbar horsepower developed by the test locomotive is of interest and has been plotted separately on Figs. 5, 6, and 7, respectively, for each type of locomotive used. The figures represent the adjusted horsepower that would have been delivered at the rear of the tender if the locomotive had been running at constant speed on level tangent track.

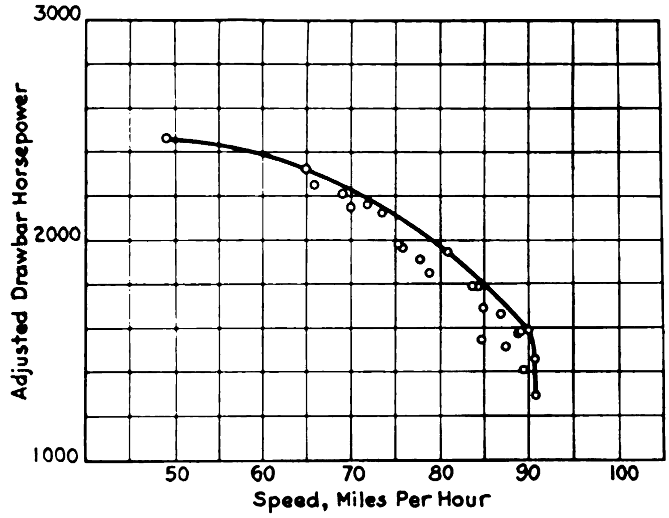


Fig. 5—Highest values of adjusted drawbar horsepower—Pennsylvania class K4s locomotive

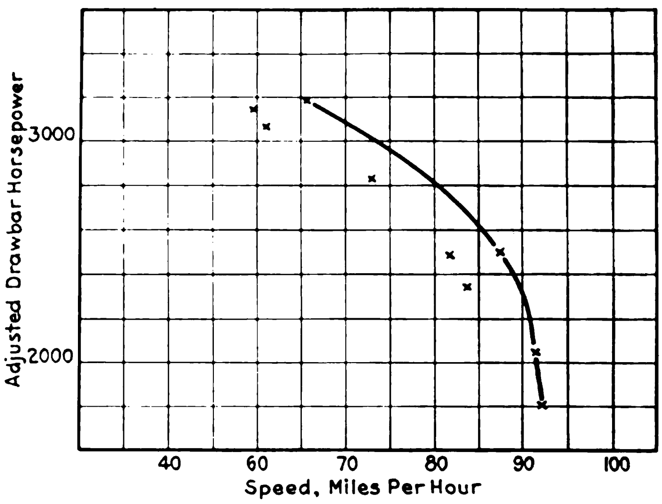


Fig. 6—Highest values of adjusted drawbar horsepower—C. & N. W. Class E4 locomotive

Acceleration Distances for Various Horsepowers—1,000 Tons Trailing Load

Maximum drawbar horsepower	Distance, miles, to accelerate between speeds of, m. p. h.		
	0-50	50-80	80-100
3,000	1.51	13.98	....
4,000	1.13	6.36	....
5,000	0.93	4.41	29.00
6,000	0.80	3.48	10.74
7,000	0.71	2.92	7.13

Rate of Acceleration—Tests

The Davis curve in Fig. 4 shows that the resistance of the test train on level tangent track at a speed of 100 m.p.h. is 12.67 lb. per ton and, therefore, to haul the test train weighing 1,000 tons at a speed of 100 m.p.h. on level tangent track will require a drawbar pull of 12,670 lb. and a horsepower of 3,379 delivered at the

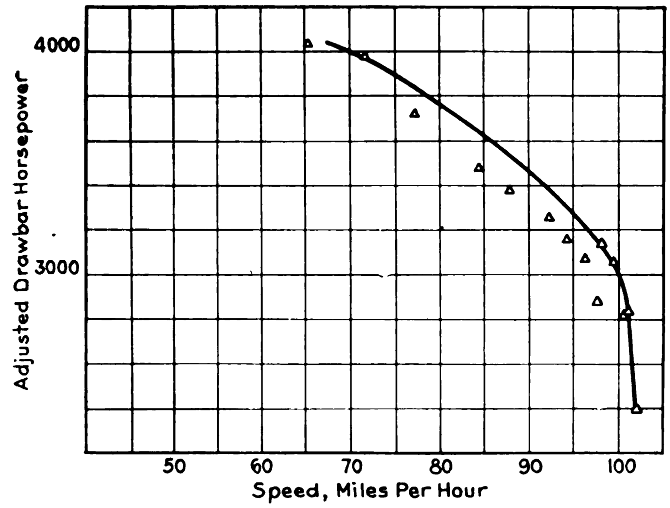


Fig. 7—Highest values of adjusted drawbar horsepower—Union Pacific Class FEF1 locomotive

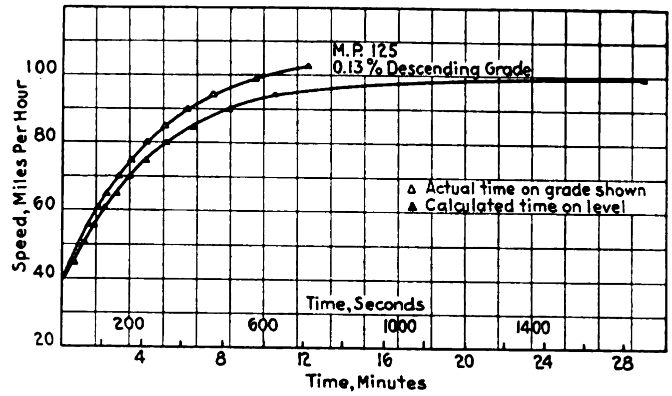


Fig. 9—Speed-time curve of the Union Pacific 4-8-4 type locomotive hauling the test train

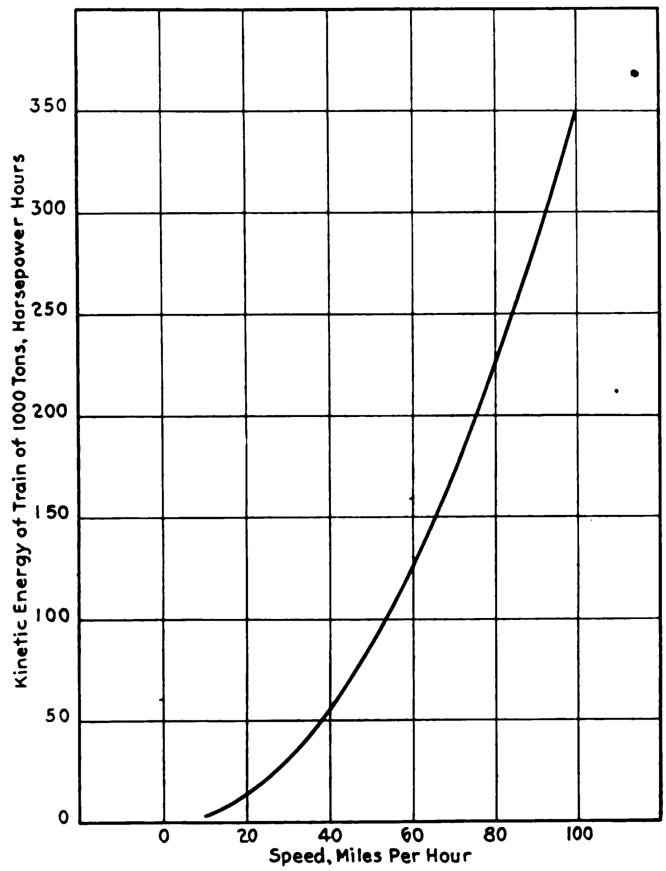


Fig. 8—The kinetic energy stored in a 1,000-ton train at various speeds

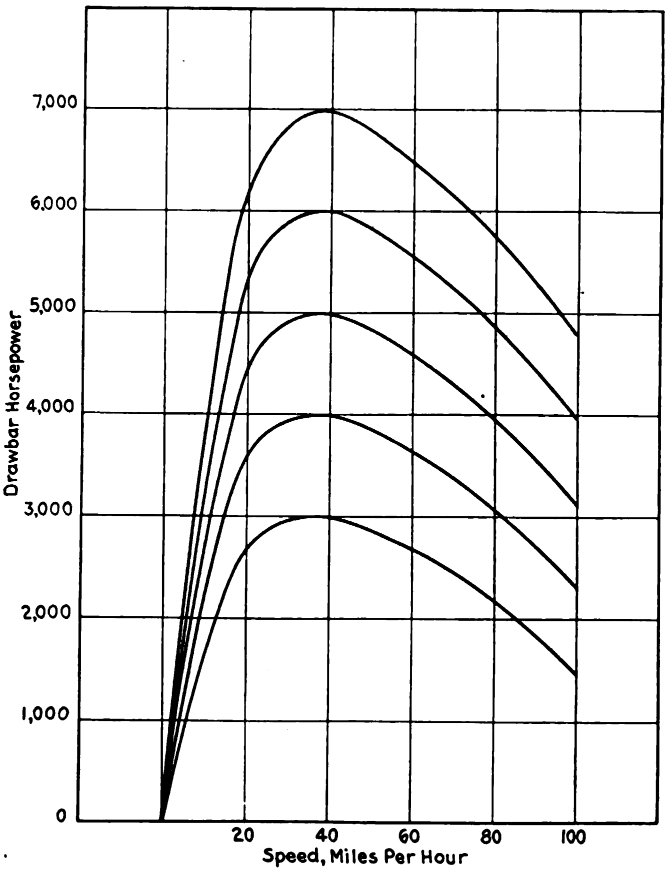


Fig. 10—Calculated drawbar-horsepower-speed curves for locomotives developing 3,000 to 7,000 drawbar horsepower

rear of the tender. This is a comparatively moderate power; but, if a train is to run at 100 m.p.h., it must first be accelerated up to that speed and the rate of acceleration will depend upon the amount of power that can be delivered by the locomotive in excess of that required to haul the train at a constant speed. The kinetic energy of the train, which must be supplied by this excess power, varies as the square of the speed, as shown by the curve on Fig. 8.

In conducting the high-speed tests, as the maximum speed was approached, the great time and distance required to make a small increase in speed became very noticeable. The highest speed of the tests was made on the Union Pacific, and the acceleration curve shown in Fig. 9 shows that it required 7 min. to accelerate from 80 to 100 m.p.h., although the train was on a descending grade of 0.13 per cent. On the same diagram is another curve showing how the speed would have increased if the grade had been level. It would then have required 16 min. 10 sec. to reach a speed of 99 m.p.h. and no higher speed could have been obtained unless the locomotive could develop more horsepower than it did in the test.

Rate of Acceleration—Calculated

After the running resistance has been determined, the time and distance required to accelerate a train can be calculated for any given drawbar horsepower, but since the mass of the locomotive and tender must also be accelerated, their weight must be known or assumed and taken into account.

To be able to plot a series of acceleration curves approximating actual conditions with existing steam locomotives, a series of drawbar horsepower-speed curves

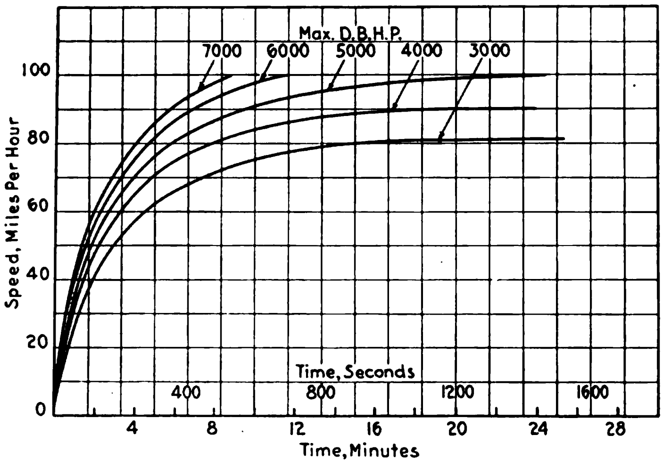


Fig. 11—Speed-time curves for a 1,000 ton train (trailing load) on level tangent track, with drawbar horsepowers from 3,000 to 7,000

have been plotted in Fig. 10 for locomotives developing maximum drawbar horsepowers of 3,000 to 7,000. These curves were obtained from the Cole formula for cylinder horsepower which assumes that the indicated horsepower remains constant above a piston speed of 1,000 ft. per min. For each curve 25 lb. per ton of estimated weight on drivers was deducted from the cylinder tractive force in accordance with American Locomotive Company practice to get the horsepower developed at the drivers, after which the resistance of the engine, trailer, and

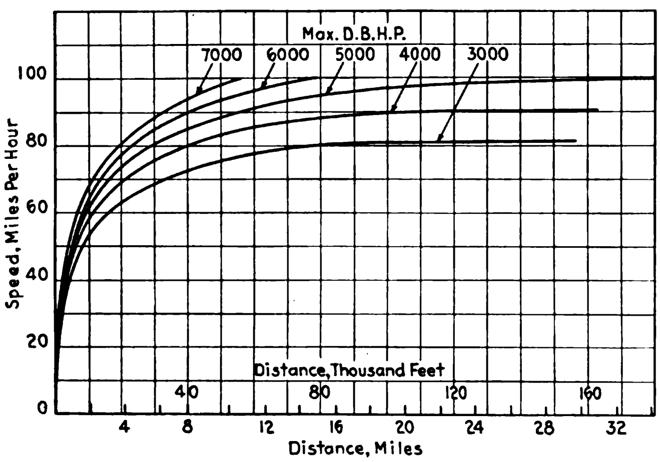


Fig. 12—Speed-distance curves for a 1,000 ton train (trailing load) on level tangent track, with drawbar horsepowers from 3,000 to 7,000

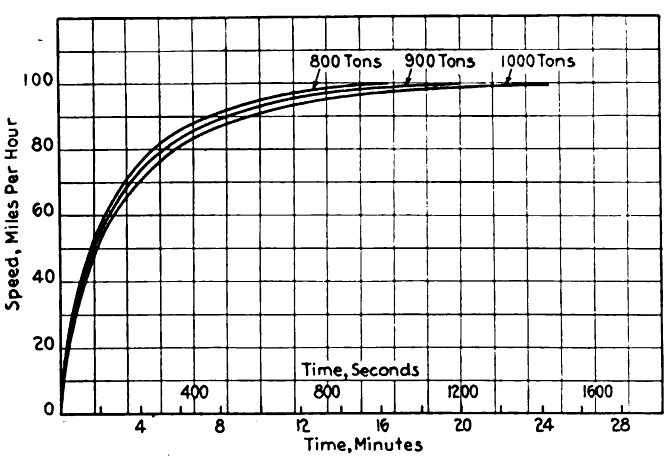


Fig. 13—Speed-time curves for various trailing loads on level tangent track, hauled by a locomotive developing 5,000 maximum drawbar horsepower

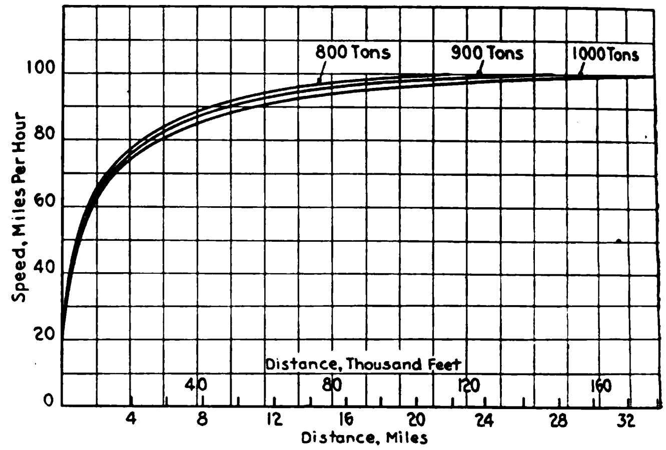


Fig. 14—Speed-distance curves for various trailing loads on level tangent track, hauled by a locomotive developing 5,000 maximum drawbar horsepower

tender trucks, and the head end air resistance was calculated by the Davis formula and deducted to determine the horsepower delivered at the rear of the tender. The curves in Fig. 10 do not represent actual locomotives, but they will serve to show the relation between power and rate of acceleration and closely represent what is now attained in actual practice.

Acceleration curves, based on these calculated horsepower curves, are shown in Figs. 11 and 12.

With a maximum of 5,000 drawbar horsepower, it requires only 0.93 miles to accelerate to 50 m.p.h., another 4.4 miles to accelerate to 80 m.p.h., and 29.0 additional miles to accelerate to 100 m.p.h. In other words, if after reaching a speed of 100 m.p.h., the train were required to slow down to 80 m.p.h., it would require 29.0 miles on level track to get back to 100 m.p.h. It is evident that if much running is to be done at a speed of 100 m.p.h., the rate of acceleration will have to be much faster than this, and a locomotive developing a maximum of only 5,000 hp. will not be large enough if its horsepower-speed curve is similar to that in Fig. 10.

Reference to Fig. 12 shows that it takes longer to

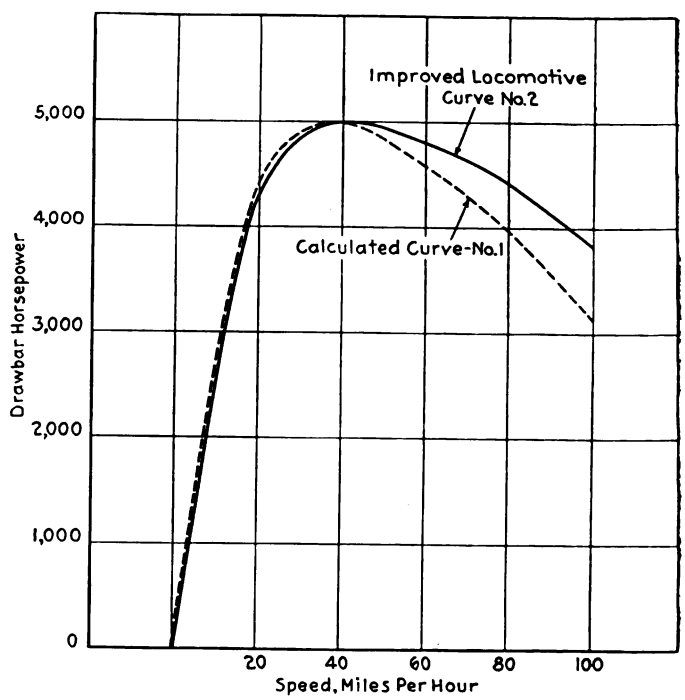


Fig. 15—Comparison of calculated and "improved" drawbar-horsepower-speed curves—5,000 maximum drawbar horsepower

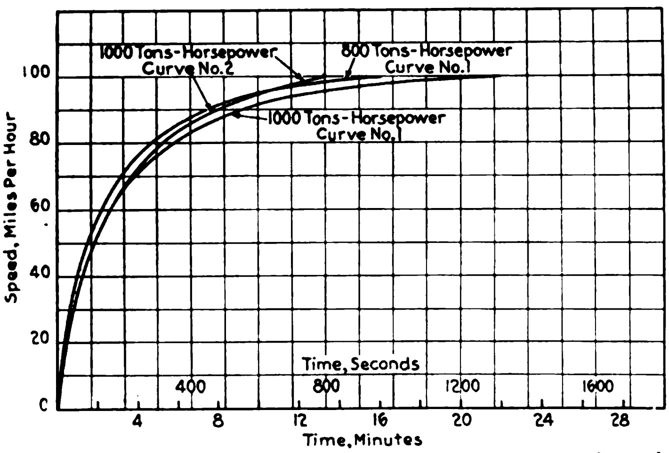


Fig. 16—Comparison of speed-time curves for standard-weight and lightweight trains hauled by locomotives with calculated and "improved" drawbar-horsepower curves

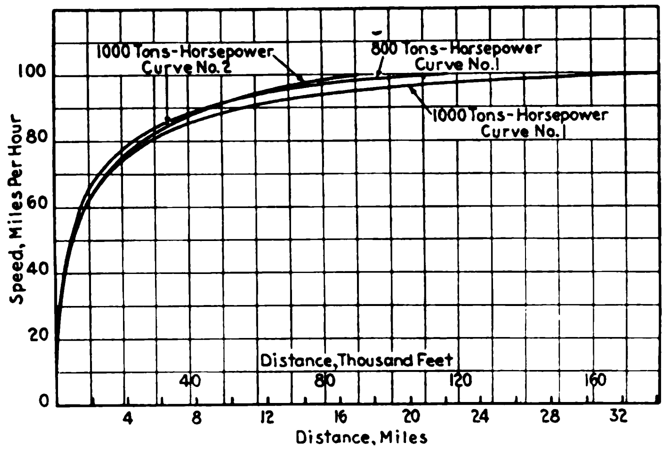


Fig. 17—Comparison of speed-distance curves for standard-weight and lightweight trains hauled by locomotives with calculated and "improved" drawbar-horsepower curves

accelerate from 80 to 100 m.p.h. than it does to accelerate from 0 to 80 m.p.h. The difference in acceleration, time and distance is much greater at the higher speeds than it is at the lower speeds. The curves in Fig. 11 make it clear that when the drawbar horsepower decreases at the higher speeds, the time required to accelerate at these higher speeds is lengthened, and to make high-speed running practicable it is important to increase the maximum cylinder horsepower developed by the locomotive to overcome mechanical friction to sustain maximum drawbar horsepower at higher speeds.

Effect of Grade on Acceleration

All the curves so far discussed have been based on running on level tangent track. Running downhill will, of course, increase the rate of acceleration, and running uphill will decrease the rate. On a 0.1 per cent ascending grade, a 5,000 drawbar-horsepower locomotive will not accelerate the 1,000-ton train beyond a speed of 92 m.p.h. Even on a 0.3 per cent descending grade it will require about 5.65 miles to accelerate the train from 80 to 100 m.p.h.

Effect of Reduction in Weight of Train on Rate of Acceleration

If the power delivered by the locomotive cannot be increased enough to produce a satisfactory rate of acceleration, the time and distance required to reach high speed can be shortened by decreasing the weight of the train. The time and distance required to accelerate trains of three different weights have been plotted in Figs. 13 and 14, basing them on a locomotive developing a maximum of 5,000 drawbar horsepower. Reducing the weight of the train from 1,000 tons to 800 tons reduces the time and distance required to accelerate from 0 to 100 m.p.h. about 35 per cent. This is a very important gain. There is, however, another way to look at it. The curves also show that when the 800-ton train has reached a speed of 100 m.p.h., a 1,000-ton train will have reached a speed of 97.5 m.p.h., a difference of only 2.5 m.p.h. in speed.

In order to find out how much additional power would be required to accelerate the 1,000-ton train at the same rate as the 800-ton train, a new drawbar horsepower curve was assumed for a 5,000-drawbar-horsepower locomotive. This curve is shown in Fig. 15 in comparison with the corresponding curve in Fig. 10. It represents a moderate improvement in the power developed at high speeds which it should be possible to secure. The resultant acceleration curves are shown in Figs. 16 and 17. The improved locomotive will accelerate the 1,000-ton train to 100 m.p.h. in slightly less time and distance than the 800-ton train will require when handled by the other locomotive. If long trains are to be handled at a speed of 100 m.p.h., undoubtedly there will be required a reduction in the weight of the train as well as an improvement in the power produced by the locomotive at high speed.

General Observations

Nothing developed in the tests to indicate that any of the locomotives had reached the limit of boiler capacity. Therefore, the question of sustained power at high speeds becomes a question of mean effective pressure in the cylinders. It is evident that if the mean effective pressure remains constant as the speed increases, the power of the locomotives will increase with speed; but since the mean effective pressure for any given cycle of valve events necessarily decreases with the speed, the ideal locomotive must have port openings so large and so accurately timed that this decrease will be kept as low as possible until the maximum speed has been reached. Obviously, the mean effective pressure cannot be successfully sustained by lengthening the cut-off. On the other hand, high speeds should be accompanied by shortened cut-off. The factors of design which have a direct bearing on maximum mean effective pressure are as follows: (1) high boiler pressure; (2) minimum pressure drop from boiler to steam chest; (3) large steam chest volume; (4) maximum valve port openings; and (5) minimum back pressure in exhaust passages.

Other factors that affect the power delivered to the drawbar are machinery friction, rolling resistance, and head-end air resistance.

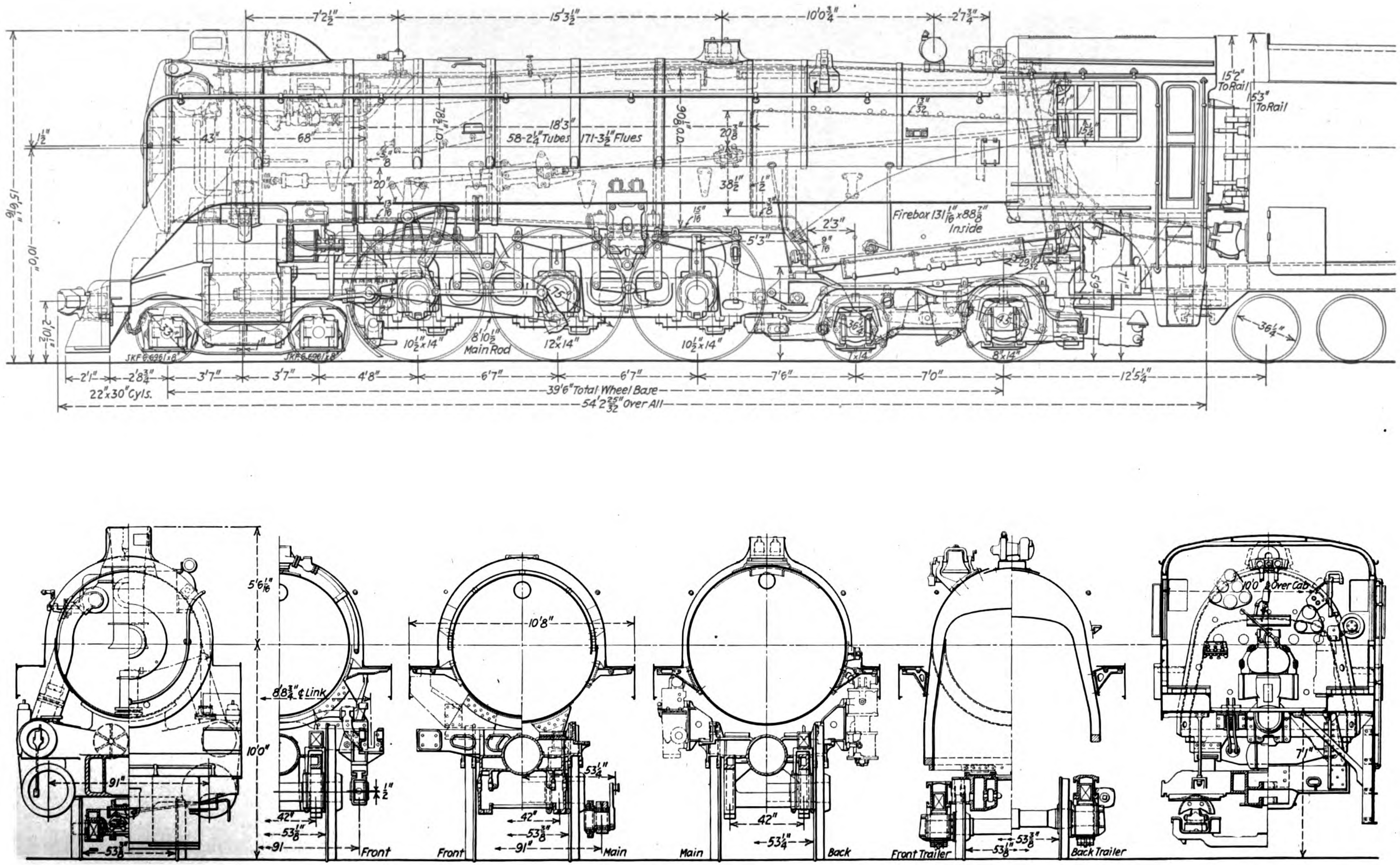
Conclusions

1—The maximum speed reached in the test was 102.4 m.p.h. After acceleration from a speed of 50 m.p.h. over a distance of 13 miles on a descending grade of 0.13 per cent, a speed of 100 m.p.h. was reached and maintained for 6 miles.

2—An estimate of the power required to haul passenger trains at high speed should be based on the Davis formula.

3—After the 1,000-ton test train had been accelerated to a speed of 100 m.p.h., it required 3,379 adjusted drawbar-horsepower to maintain that speed on level tangent track.

4—The table shows the distance which would be required to accelerate the 1,000-ton test train at various speeds and horsepower.



Elevation and cross section erecting drawings of the C. P. R. Class H-1-d locomotive

C. P. R. 4-6-4 Locomotives

Latest group of semi-streamline six-coupled passenger locomotives built by Montreal Locomotive Works have 57,250 lb. tractive force, with booster

THE delivery in August, 1938, of ten 4-6-4 type semi-streamline passenger locomotives to the Canadian Pacific brings the total number of locomotives of this same basic design to 60, all of which have been built by the Montreal Locomotive Works. These new locomotives and their predecessors of the same type are used in comparatively high-speed service on various divisions of the system, one run being between Fort William, Ont., and Toronto, a distance of 813 miles, and another run between Winnipeg, Man., and Calgary, Alta., a distance of 832 miles.

The first of these Hudson-type locomotives, known as the Class H1a, 2,800 series, were built in 1929. One lot of 10 was built in that year and 10 additional built in 1930. These 20 locomotives were of conventional design. The H1b class, comprising the second group of 10, were described in the *Railway Mechanical Engineer,* April, 1931, page 167. In 1937, 30 locomotives, known as the H1c class, were delivered to the Canadian Pacific. These were followed in 1938 by the H1d class which is described in this article. Both of these latter two classes, comprising a total of 40 locomotives, are semi-streamline. With this exception and the fact that 12 out of the 60 locomotives are equipped with boosters no major differences in design exist.

On these most recent locomotives, the shrouding has been designed to simplify the general external appearance and to effect a more satisfactory lifting of smoke. While the boilers are of the conical type, the planished-steel jacket is cylindrical in form around the barrel of the boiler, resulting in straight boiler lines from the front end to the front of the firebox. The piping and fittings, wherever possible, have been concealed under the jacket. The feed-water heater has been lowered in order to reduce the prominence of its projection. A streamline cowl around the stack embodies the number plates and also conceals the whistle. The pilot and front-end shrouding is of plate construction, extending across the whole front of the locomotive. The smokebox front is plain in design and the headlight is set into the front with the lens flush with the contour of the front. Access to the front is through a removable center section.

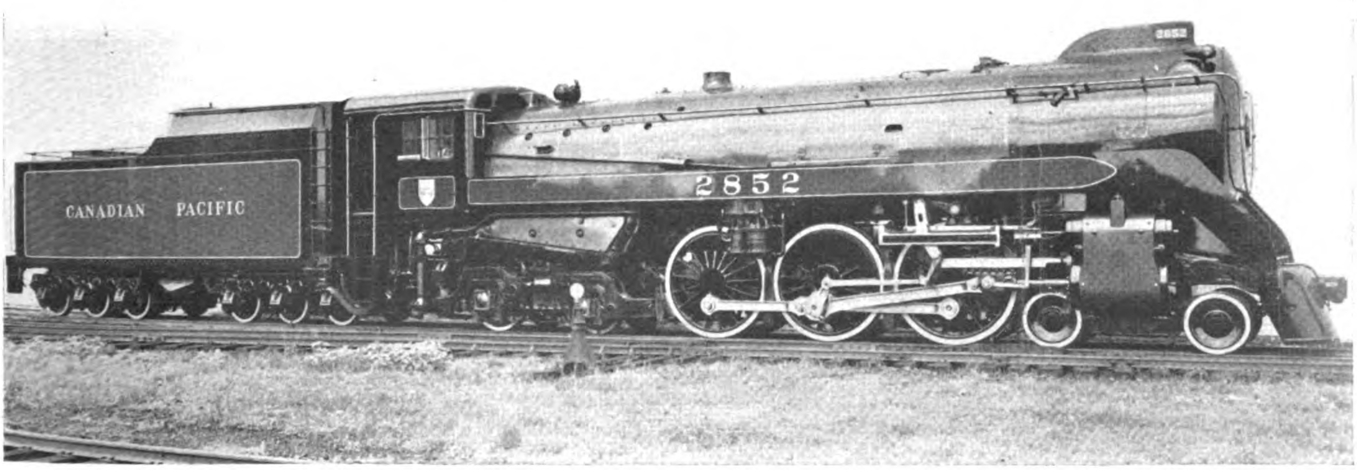
The Boiler

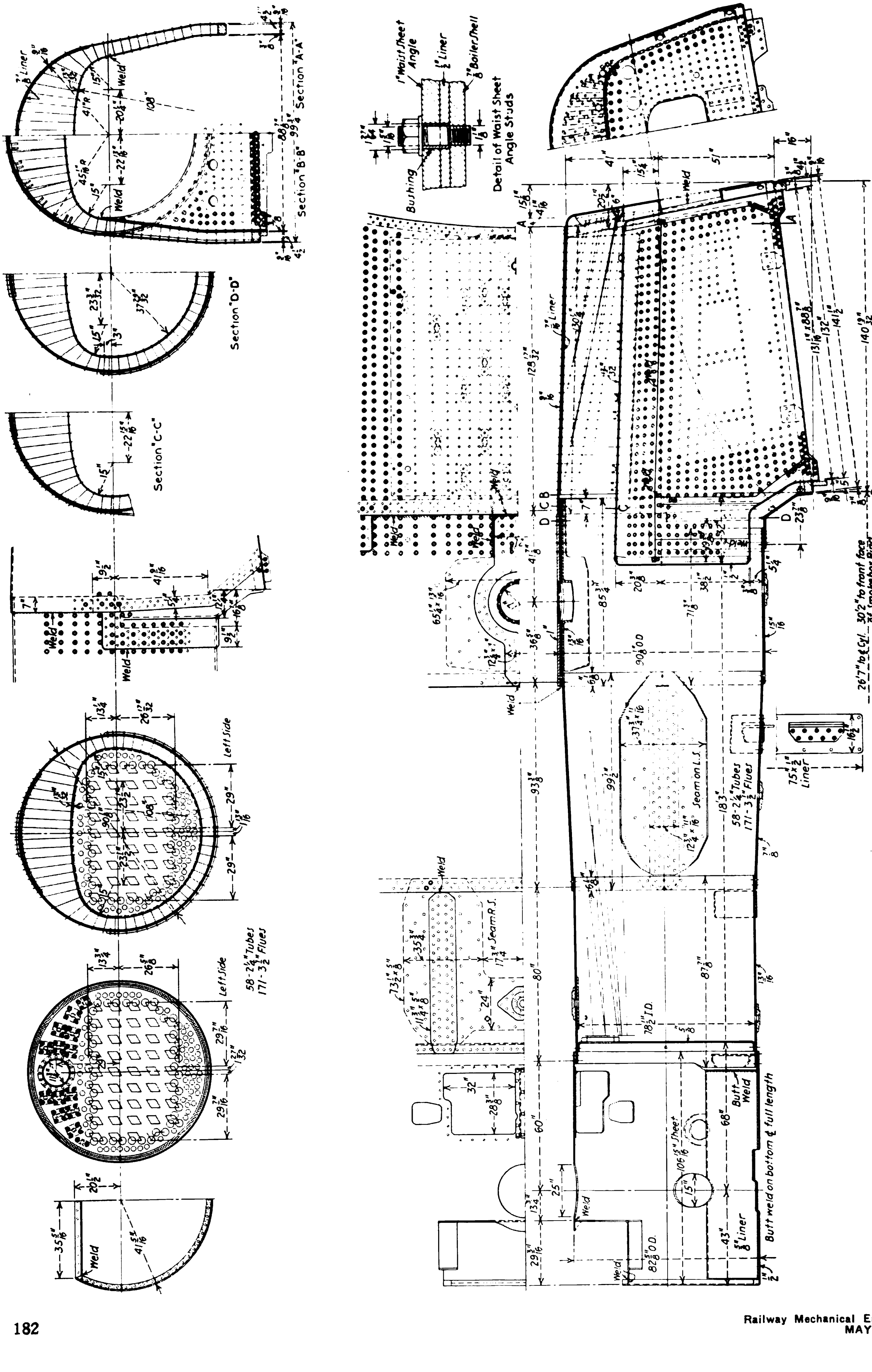
The boilers on these locomotives are of the conical type, built in three courses with combustion chamber. An unusual feature of the design is that the steam dome has been omitted. Steam enters an internal drypipe through a series of serrations at the rear end of the pipe. These openings are milled channels 5/16-in. wide separated by 3/8-in. bridges. There are 65 of these openings in the top of the drypipe extending over a length of 3 ft. 8 11/16-in. The projected length of each opening, across the pipe, is about 4 1/2 in.

All of the plates in the boilers, with the exception of the wrapper sheet and liners, are of nickel steel. The thicknesses are as follows: first course, 13/16 in.; second course, 7/8 in.; third course, 15/16 in.; crown sheet, 13/32 in.; side and door sheets, 3/8 in.; wrapper and inside throat sheet, 9/16 in.; outside throat sheet, 7/8 in.; back head, 9/16 in.; combustion chamber, 3/8 in.; front tube sheet, 5/8 in., and back tube sheet, 1/2 in.

An extensive installation of Flannery-type flexible staybolts is used in the breaking zones of the firebox. Flexible stays are also used in the combustion chamber except for 16 rows on the bottom where rigid hollow bolts are used. The boilers have Type E superheaters with built-in multiple throttle. The fireboxes are equipped with a brick arch having four 3 1/2-in. arch tubes secured in the throat sheet and back head in arch-tube sleeves.

Other special boiler equipment consists of an Elesco Type H-40 feedwater heater, Type 2-W-60 Hancock Inspirators of 6,250 gal. capacity, Franklin No. 8-A firedoor, Okadee blowoff cocks, and World Consolidated flanged-base safety valves. The grates are of the Rose-





Sectional elevation and cross sections of the C. P. R. 4-6-4 type locomotive boiler

bud type and fuel is fed by a Standard type HT stoker.

The total evaporation of these boilers is estimated at 56,045 lb. per hr., which is approximately 11 per cent greater than the maximum requirements.

The Running Gear

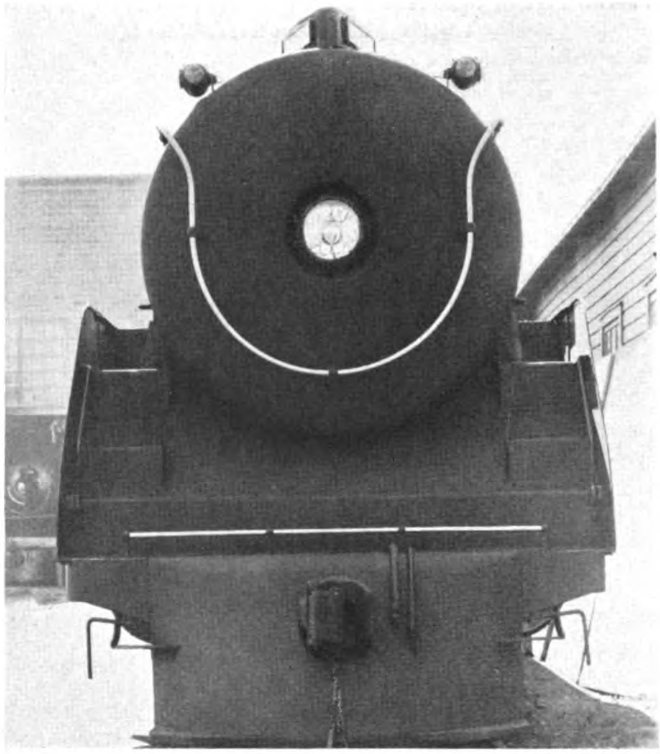
The foundation of the locomotive is a General Steel Castings Corporation steel-bed casting in which the cylinders and air reservoirs have been cast as an integral part. The engine, trailing, and tender trucks are of Commonwealth design.

With the exception of the engine truck, all of the journals run in plain bearings. SKF roller bearings of the inside-journal type are used on the leading truck. The front and back driving journals are 10½ in. by 14 in. and the main journals are 12 in. by 14 in. The main journals run in Grisco type driving boxes and the front and back driving boxes are of the conventional type. The hub liners are cast bronze and the box crown brasses of nickel bronze. All driving boxes are equipped with Franklin grease lubricators and spreader castings. The driving wheels are of the conventional spoke type mounted on axles with ground journals. The main crank pins are hollow-bored nickel steel.

The wheel diameters are as follows: leading truck, 33 in.; drivers, 75 in.; front trailing truck, 36¼ in., and the rear trailing truck, 45 in. The tender truck wheels are 36¼-in. diameter.

Five of the locomotives of the H1d class are equipped with the Franklin booster driving on the rear trailing-truck axle.

The cylinders of these locomotives are 22 in. by 30 in. and the piston valves are 12 in. in diameter. Both the cylinders and valve chambers are fitted with cast-iron bushings. The piston heads are of the Z-type, cast steel, with Hunt-Spiller bronze-lipped rings. The piston rods are carbon steel and the Dean type crossheads have a cast nickel-steel body with forged-steel shoes lined with Durite metal wearing surfaces. The guides are forged



The front end

General Dimensions, Weights and Proportions of the Canadian Pacific 4-6-4 Type Locomotive

Railroad	Canadian Pacific
Builder	Montreal Locomotive Works
Type of locomotive	4-6-4
Road class	H1d
Road numbers	2850–2859
Date built	August, 1938
Service	Passenger
Dimensions:	
Height to top of stack, ft.-in.	15-6 1/16
Height to center of boiler, ft.-in.	10-0
Width overall, in.	10-8
Cylinder centers, in.	91
Weights in working order, lb.:	
On drivers	(a) 188,200
	(b) 186,700
On front truck	(a) 61,500
	(b) 60,500
On trailing truck	(a) 105,700
	(b) 115,900
Total engine	(a) 354,000
	(b) 363,100
Tender	289,000
Wheel bases, ft.-in.:	
Driving	13-2
Rigid	13-2
Engine, total	39-6
Engine and tender, total	80-6¼
Wheels, diameter outside tires, in.:	
Driving	75
Front truck	33
Trailing truck, front	36¼
Trailing truck, back	45
Engine:	
Cylinders, number, diameter and stroke, in.	2-22 × 30
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7
Steam lap, in.	1⅛
Exhaust clearance, in.	¼
Lead, in.	¼
Boiler:	
Type	Conical
Steam pressure, lb. per sq. in.	275
Diameter, first ring, inside, in.	78½
Diameter, largest, outside, in.	90⅛
Firebox length, in.	131 1/16
Firebox, width, in.	88⅞
Height mud ring to crown sheet, back, in.	66¼
Height mud ring to crown sheet, front, in.	86⅜
Combustion chamber length, in.	27⅛
Arch tubes, number and diameter, in.	4-3½
Tubes, number and diameter, in.	58-2¼
Flues, number and diameter, in.	171-3½
Length over tube sheets, ft.-in.	18-3
Fuel	Bituminous coal
Grate type	Rosebud
Grate area, sq. ft.	80.8
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	288
Arch tubes	38
Firebox, total	326
Tubes and flues	3,465
Evaporative, total	3,791
Superheat.	1,542
Combined evap. and superheat.	5,333
Tender:	
Type	Rectangular
Water capacity, U. S. gal.	14,400
Fuel capacity, tons	21
Trucks	Six-wheel
Journals, diam. and length, in.	6 × 11
General data, estimated:	
Rated tractive force, engine, 85 per cent, lb.	45,250
Rated tractive force, booster, lb.	12,000
Total rated tractive force, lb.	57,250
Weight proportions:	
Weight on drivers ÷ weight, engine, per cent	51.40
Weight on drivers ÷ tractive force	4.13
Weight of engine ÷ evap. heat. surface	95.80
Weight of engine ÷ comb. heat. surface	68.20
Boiler proportions:	
Firebox heat. surface, per cent comb. heat. surface	6.10
Tube-flue heat. surface, per cent comb. heat. surface	65.00
Superheat. surface, per cent comb. heat. surface	28.90
Firebox heat. surface ÷ grate area	4.03
Tube-flue heat. surface ÷ grate area	42.90
Superheat. surface ÷ grate area	19.10
Comb. heat. surface ÷ grate area	66.00
Evaporat. heat. surface ÷ grate area	46.90
Tractive force ÷ grate area	560.00
Tractive force ÷ evap. heat. surface	11.90
Tractive force ÷ comb. heat. surface	8.50
Tractive force × diam. drivers ÷ comb. heat. surface	636.00

(a) without booster
(b) with booster

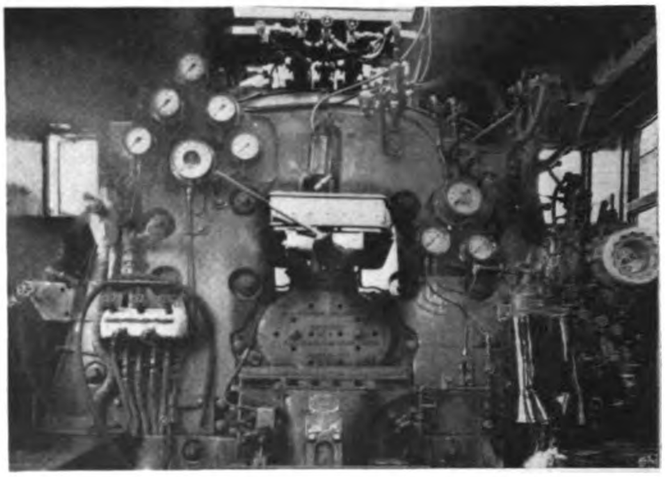
Partial List of Materials and Equipment on the Canadian Pacific 4-6-4 Type Locomotives, Class H1d

Main frame with integral cylinders; engine, trailing, and tender trucks	General Steel Castings Corp.
Air brake, engine and tender	Westinghouse Air Brake Co.
Brake shoes	Dominion Brake Shoe Co., Ltd.
Radial buffers (Type E1)	Franklin Railway Supply Co., Inc.
Brick arch	Canada Firebrick Co.
Valves; line checks	T. McAvity & Sons, Ltd.
Gages—steam heat, signal and air-brake	Morrison Railway Supply Corp.
Gages — boiler, stoker; feedwater heater	Sidney Smith. Mulcott Co.
Washout plugs (T-Z)	Consolidated Equipment Co.
Firedoor	Franklin Railway Supply Co., Inc.
Pipe unions—malleable iron	E. M. Dart Mfg. Co.
Pipe unions—forged steel	Crane Co.
Flexible staybolts (Flannery)	Allis-Chalmers Mfg. Co.
Stoker	Standard Stoker Co., Inc.
Superheater; throttle; feedwater heater and pump	The Superheater Company
Injector; main boiler check	T. McAvity & Sons, Ltd.
Air-compressor throttle valve	Westinghouse Air Brake Co.
Cylinder cocks (Okadee)	Railway & Engineering Specialties, Ltd.
Piston rings (Hunt-Spiller)	Joseph Robb & Co.
Packings	The Garlock Packing Company Anchor Packing Co. Johns-Manville Sales Corp.
Lubrication — motion, brake and spring gear, etc. (Alemite)	The Climax Co.
Lubricators:	
Force feed (Nathan)	Consolidated Equipment Co.
Air-compressor; auxiliary lubricator	Edna Brass Mfg. Co.
Driving-box cellar	Franklin Railway Supply Co., Inc.
Blow-off cocks (Okadee)	Railway & Engineering Specialties, Ltd.
Arch-tube plugs (Huron); back-pressure gage; steam-heat reducing valve (Leslie); cab lamp	T. McAvity & Sons, Ltd.
Electric headlight and generator	Pyle-National. Holden Co., Ltd.
Tender underframe	General Steel Castings Corp.
Draft gear, tender (Miner P-5-XB)	Canadian Appliance Co.
Tender clasp brake	International Equipment Co.
Tank-hose couplings (T-Z)	Consolidated Equipment Co.
Steam-heat couplings	Vapor Car Heating Co., Inc.
Flexible couplings—steam-heat connection between engine and tender; steam-heat connection rear of tender; steam line for stoker; hose for air line (Barco)	Holden Co., Ltd.

steel with the Alco Slidguide attachment. Both the pistons and the valve stems operate in King type packing. The valves are actuated by Walschaert gear, controlled by an air-operated screw reverse gear of Canadian Pacific design.

The main and side rods are forged from high-tensile nickel steel and are of the I-section design. The main crank pins operate in floating bushings running in nickel-cast-iron bushings in both the main and side rods.

The lubrication of the moving and wearing parts is provided for by both forced-feed oil and grease systems. Alemite is used on the motion work (except in the link block), main driving boxes, brake and spring rigging, while the Spee-D system is utilized on the main and side rods and the back end of the eccentric rods.



Arrangement of cab interior

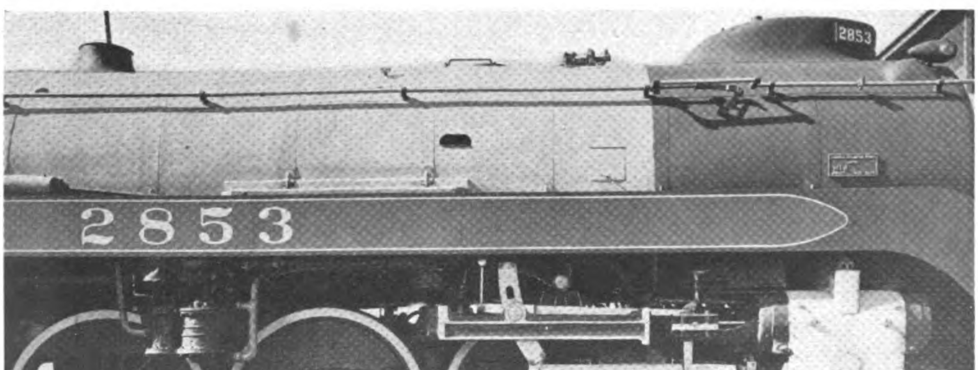
Mechanical oiling by means of a Nathan DV-4 eight-feed lubricator takes care of the cylinders, valves, water pumps, air pumps, guides, and stoker engine. Four-way dividers are used on the guides.

The air-brake equipment is the Westinghouse Schedule No. 8 ET with an 8½-in. cross-compound compressor mounted on a bracket attached to the bed on the right side of the locomotive. The feedwater heater pump is mounted on a similar bracket under the runboards on the opposite side.

A feature of these locomotives is a recent design of vestibule-type cab in which the exterior walls are constructed of copper-bearing-steel plate and the interior walls and roof of No. 18- and 20-gage copper-bearing-steel sheet. Johns-Manville 1-in. insulation is used between the inner and outer walls. The flooring is of 2-in. white pine.

The Tenders

The tenders are of the rectangular type with the General Steel Castings Corporation's water-bottom underframes and riveted tank construction. The tanks are of copper-bearing steel and have a capacity of 12,000 Imperial gallons (14,400 U. S. gal.) The coal capacity is 21 tons. The tender trucks are the six-wheel type equipped with clasp brakes operated by 10-in. by 14-in. brake cylinders. Barco flexible connections are used on the steam-heat and stoker lines between the engine and tender and on the steam-heat line at the rear of the tender.



The running gear is exposed to view, facilitating inspection. The air compressor is located beneath the runboard on the right side while the feedwater pump is in a similar location on the left side

One of ten auxiliary water cars equipped for service with 2-10-4 type locomotives on the Chicago Great Western

Auxiliary Water Cars Effect Savings

By building 10 auxiliary water cars for use on its Iowa division between Oelwein, Iowa, and Kansas City, Mo., the Chicago Great Western has eliminated an average of three water and coal stops per train over the division. This has resulted in eliminating more than an hour in running time, increasing the train load, savings in fuel and the conversion of one coaling station and four water stations from regular operation to emergency stations. Regular water stops are now confined to the stations where superior water is available, resulting in better locomotive performance. The auxiliary water cars have tanks of 10,000-gal. capacity, and are used in conjunction with 2-10-4 type locomotives having a tender capacity of 14,000 gal. which gives each locomotive a total water capacity of 24,000 gal.

Tank Construction

To build these tanks, the dome of an ordinary tank car was cut off just above the top of the tank. A flat steel plate was then welded on and manhole covers applied similar to those used on the tender. The manholes are 18 in. wide by 48 in. long, and are equipped with a double cover. The height is the same as that of the tenders, so that both tanks may be filled to capacity.

A wooden platform about 78 in. square is built around the manhole and equipped with a ladder on each side, leading down to the original longitudinal running boards. A hand railing of suitable height extends entirely around the tank, and the platform is also equipped with two hand rails, applied as illustrated so that the penstocks may be adjusted to fill the tank with minimum manipulation.

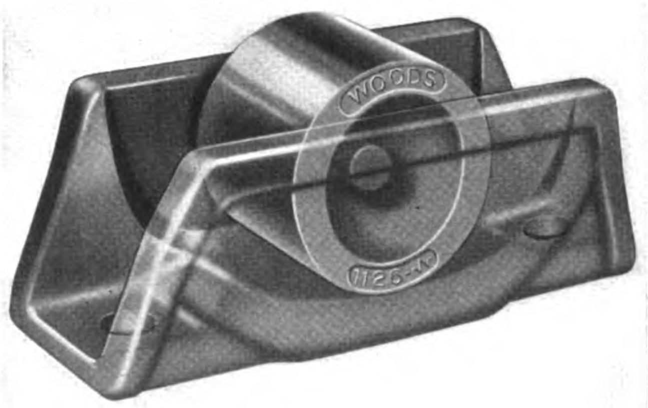
Two splash plates divide the tank into three equal compartments to minimize the surging of water. Only one end of the tank is provided with water piping. The water connection consists of a 4-in. valve on the bottom of the auxiliary tank, another 4-in. valve on the bottom of the rear end of the tender, a 4-in., 45-deg. ell on the tank, a 45-deg. T-Z hose connection on the tender, a 4-in. hose of suitable length and the necessary pipe nipples and clamps. Engine injectors are connected with the primary tank only.

A ¾-in. steam-pipe connection, with the necessary ball joints, leads from the primary tank to the auxiliary tank and discharges directly into the 4-in. water-pipe connection. This heats the water sufficiently to prevent freezing in cold weather. The steam is obtained from the steam line used for heating the head brakeman's cabin on the rear of the tender. Standard coupler connections are used between the auxiliary and the primary tanks, making it unnecessary to increase the length of turntables or other enginehouse facilities, and permitting the convenient interchange of the auxiliary tanks from one locomotive to another.

Roller Side-Bearing Is Improved

Improvements have been made recently in the gravity-centering type of roller side-bearing which Edwin S. Woods & Company, Chicago, has developed to meet A. A. R. specifications and which has been applied in the past few years to thousands of railroad freight cars of all types.

The rolled-steel, heat-treated roller formerly used in this side bearing has been replaced by a forged-steel roller which provides additional strength, and, together with a forged-steel housing of strong but lighter design, reduces the weight of the bearing by 20 lb. per car set. The new roller, with a 4-in. outer diameter and 3-in.



Improved Woods forged-steel roller side bearing

face, has equalized metal sections, by virtue of the web and rim construction, illustrated, which permit more uniform heat treatment throughout. The rim of the roller is ¾ in. thick and the web is of the same thickness, thus assuring equal heat penetration and uniform strength in all parts of the roller. The heat treatment provided gives a hardness of 320 Brinnell with S. A. E. 1050 steel. Each roller weighs 2½ lb. less than the earlier design.

The forged-steel roller housing of the same general design as formerly employed, is made of S. A. E. 1060 steel, heat treated to a hardness of 310-320 Brinnell, and has the side-wall thickness reduced from ½ in. to 7/16 in., which saves another 2½ lb. per housing. The roller is centered by gravity, as in the earlier design. Minimum clearance is provided between the housing side walls and the roller, thus assuring a true position of roller at all times. The roller-stops, at the limit of travel, are of the same contour as the roller and contact it through one-quarter of its circumference. The slight slippage which occurs at the end of the travel causes the roller to return to the center in a new position.

Recent tests of the new side-bearing, conducted by an independent physical testing laboratory, indicate that it has been designed with a large factor of safety. The roller was tested between two hardened-steel plates under a load of 300,000 lb., the maximum pressure which could be exerted in the testing machine. It is reported that with this load, far in excess of any pressure encountered under the most severe service conditions, the roller showed no evidence of distress or prospective failure, the outer diameter of 4 in. being reduced only .05 in. at the line of contact with the hardened-steel plates.

The Burlington's "General Pershing"

(*Continued from page 174*)

speed and the Decelostat mechanism returns to its normal position, breaking the electric contact and de-energizing the magnet. The Decelostat valve then operates automatically to restore brake-cylinder pressure to the original value.

A lamp is placed in the operator's cab which lights when any Decelostat in the train operates, thus providing a visual indication to the engineman that he is braking up to the adhesion point of the rails.

Prior to being placed in service, the new General Pershing train was subjected to extensive brake tests by the railroad. These tests have demonstrated the general reliability and satisfactory performance of the new braking equipment. For instance, a stop from a speed of 91 m.p.h. was made in 35 sec. and a distance of 2,415 ft. A subsequent stop from 100 m.p.h. is reported to have been made in 46 sec. and a distance of 3,157 ft.

The Traction Power Plant

The traction power plant is installed in a 26-ft. engine-room in the leading unit of the train. It is a standard 12-cylinder, 1,000-hp. Diesel-electric power plant built and installed by the Electro-Motive Corporation, a subsidiary of General Motors. The Electro-Motive Corporation also built the one-piece welded molybdenum-steel front section of the underframe and the all-welded alloy-steel six-wheel power truck. This truck is equipped with Hyatt roller bearings, and the bearings are nominally 6 in. by 11 in.

The Interior Decorations

The interior decorations of the passenger-carrying cars are suggestive of the tones of the autumn landscape. In the coaches and lounge the colors are light sandstone, and brown. The seats are upholstered with Massachusetts mohair plush in tones of brown and rust, and the Chase Seamloc carpets are a mahogany-and-rust mixture. The walls and ceiling in the dining room are flesh-tinted light drab, with raisin upholstery on the chairs and a henna rust Seamloc carpet with an insert pattern in sand. Sand drapes with brown stripes are placed at the coach windows. Color is given in the dining room by variegated drapes in tones of red, orange, brown, and tan. A variety of weaves of mohair upholstery in turquoise, chamois, and dark brown on a jade and brown Seamloc carpet are livened by the use of golden-yellow drapes at the windows of the lounge compartment.

An oil portrait of General Pershing, balanced by a companion painting showing a facsimile of the General's signature, and drawings symbolic of his achievements, honors, and integrity are placed on the front walls of the lounge section. These paintings are applied to stainless steel by a new technique developed by Buell Mullen, the artist. The technique includes the backing-on of a protective coating at high temperatures, which gives permanence to the paintings and a peculiar three-dimensional effect.

The styling and colors of the interiors of the passenger-carrying cars in this train were developed by Paul Cret.

Locomotive Slipping Tests - Correction

In the two-part article entitled "Locomotive Slipping Tests" which appeared in the March and April issues, the following corrections should be noted: March issue, page 87 Table III, Main driver crossbalance, A. A. R. Method, last column of table, under locomotive Class M-4-a, the value should appear as minus 51 lb. instead of plus 51 lb. April issue, page 135, second column, paragraph (b) fifth line should read: " . . . the over-balance in itself without reducing reciprocating weight . . ." Page 138, second column, in the equation following the phrase " . . . and the maximum value of X will be", ω was omitted from the denominator in the last fraction which should have read (P^2 minus ω^2). Also, in the equation for the derivation of the value of ω the numerator of the fraction under the last radical of the equation should read (K plus K_{rail})g instead of (K minus K_{rail})g.

* * *

EDITORIALS

The Patron Be Damned!

In the old swashbuckling days when railways held a transportation monopoly against which the public had not yet taken measures to protect itself, the famous statement of Cornelius Vanderbilt in a moment of irritation, "The Public Be Damned!," all too accurately expressed the psychology of railroad officers in dealing with the public they were in business to serve. Then came regulation and public resentment which effectively cured such tactlessness of approach to matters of public relations.

Curiously enough the same underlying premise, of which this famous statement was but an extreme expression, still colors the attitude of far too many responsible railway officers in some matters affecting their patrons. This may be the heritage of three generations of monopoly, during which the railway industry had to give little attention to the wishes of its patrons. Such wishes were quite completely subordinated to the convenience of the railroads in meeting their own needs for a constant increase in operating economy.

The force of competition is now directing attention to the wishes of the patron. This is evident in the marked speeding up of both passenger and freight service and in the attention which has been given to other methods of making both services more attractive, including rate adjustments. The new de luxe high-speed trains, with their luxurious interior appointments and improved riding comfort, are striking bids for new patronage. But with the patronage which seems secure —the traffic on the conventional main-line trains, the commuters and such local travel as still remains— quite a different attitude is evident. Here the old impersonal attitude that the railroad is run for the convenience of its operating department again shows itself.

One of the worst offenses in this respect is the continued attempts at handling passenger trains of conventional equipment of such lengths that rough handling seems inevitable. Such trains are highly effective as measures for operating economy, but when the comfort of a good Pullman berth is offset by the discomfort of violent shocks each time the train starts, the railroad is jeopardizing its own future passenger business and, indeed, is undermining the future of all steam railways as passenger transportation agencies.

Steam locomotives can be built today, and, indeed, some of them are now in service, which will handle from 1,200- to 1,500-ton trains—all the cars that can be heated—on schedules which require top speeds of from 70 to more than 80 m.p.h. Made up of conventional rolling stock, such trains handle a good deal like freight trains. The slack is a great help in starting, but a cause of great annoyance to the patron trying to rest.

When there was no other way to travel but by rail, such conditions were accepted as necessary. Today, railroads compete with the airways and the highways. They can maintain a strong competitive position only by recognizing the fact that the kind of service the patron wants is more important than the kind of service the railroad finds it most convenient to render. This does not necessarily mean a complete sacrifice of operating efficiency. It does mean, however, that operating efficiency must receive secondary consideration. If 1,200- to 1,500-ton passenger trains are essential to operating economy, they must be first equipped with tight-lock couplers and smooth-operating draft gears. And then the motive power must exert sufficient tractive force to start the train without dependence on slack.

Giving first consideration to the patron also implies a marked change in the customary attitude of the railways to their inventory of motive power and rolling stock—particularly that in passenger service. Such accumulations of obsolescence as are at the present time burdening the railroads are extremely dangerous in a competitive industry. As improvements in rolling stock take place, the railroads can no longer disregard them for years awaiting the wearing out of existing equipment. To do so will be to risk a loss of market to other more progressive transportation agencies.

Locomotive Availability Versus Utilization

The vast difference between potential locomotive availability and actual utilization apparently is not always fully appreciated and, as a result, erroneous conclusions may be drawn in comparing the relative merits of various types of motive power and rolling stock. Availability is ordinarily considered to be the percentage of monthly or annual time which any given piece of equipment is ready for service, excluding all time required for heavy repairs, light repairs and current conditioning and servicing work necessary for the satisfactory operation of the equipment. Utilization, on the other hand, represents the percentage of time which equipment is actually operated in useful service and depends upon service requirements, operating schedules and various factors other than the mechanical condition of the equipment.

In discussing this subject at a recent meeting of the Western Railway Club in Chicago, A. A. Raymond, superintendent of fuel and locomotive performance,

New York Central, said "I should like to differentiate clearly between utilization and availability. That is, a locomotive may be available but if the work is not there we can't take advantage of that availability. In other words, utilization is using as much as possible of the potential availability. From a railroad standpoint, it seems to me that that really is the only important item. Availability is no good if it is resting in the bank. Availability is of value to railroads only as it is used."

Extremely high records of availability up to 98 per cent have been established for certain types of relatively new Diesel motive power, for example, thus demonstrating in a most effective way the general efficiency and reliability of the design, also the well-known advantages of Diesel power in quick turn-around and minimum detention for terminal conditioning and servicing operations. In switching service, it is probable that Diesel locomotive utilization closely approaches the high percentage availability, mentioned, at least in yards and territories where the work can be organized on a three-shift basis. In this intensive use it is customary to secure fuel, water and oil supplies during the crew's 20-min. lunch periods and hold the Diesel switching power out of service for only one 8-hour shift each month for federal inspection and necessary mechanical attention. It is possible also, in a limited number of cases, to organize steam-switching service for a high degree utilization by special arrangements to furnish coal and water and dispose of ashes without sending locomotives to the enginehouse, the locomotives in this case being operated continuously for 30 calendar days, with only one day off a month for boiler washing and federal inspection at the enginehouse. This means a utilization of about 96.8 per cent.

In road service, the possibilities for continuous use of motive power of any type are greatly reduced. Even in such favorable operations as the 1,000-mile daily run of Diesel-powered passenger trains between Chicago and Denver, Colo., where equipment performance reaches the enviable record of 30,000 miles a month, there is a layover of 8 hr. each day at the end of the run which gives a utilization of only about 67 per cent. To cite one other example, the schedule recently announced for one of the new Diesel-powered streamliners calls for a daily round trip of 558 miles between two important industrial centers, the total round trip being made in 10 hr. running time and therefore representing a utilization of only 41.7 per cent. Undoubtedly, every effort will be made to find some means of extending the daily mileage and service hours of this valuable piece of equipment which has so much more potential serviceability than can be utilized in the service mentioned.

Modern steam locomotives also have shown high availabilities up to 93.4 per cent in 18 months' service, but, in the last analysis, it is the average performance of the entire locomotive inventory which produces the largest effect on railroad earnings. Napoleon is reported to have said on one occasion, quoting freely, "We must win engagements by force, but the important question is what we do the ***next day*** after the battle." In other words, it is the average performance over a period of time which measures the value of any piece of equipment.

As regards steam motive power performance, therefore, some of the figures presented in Mr. Raymond's paper are significant, indicating that, among 13 of the largest railroads in the country, the highest average number of miles per active locomotive day was 254 miles in passenger service, 123 miles in freight service, and 76.8 miles in switching service. At an average speed of 41 miles per hour in passenger service, this means 6.13 working hours, or 25.5 per cent utilization. In freight service, at an average speed of 17 miles per hour the utilization is 7.29 hours, or 30.3 per cent. In switching service at 6 miles per hour, the working time is 12.8 hours a day, or a utilization of 53.3 per cent.

Utilization figures of this low order of magnitude, apply on the best operated roads and represent far better than average performance. It is obvious, therefore, that much remains to be done in analyzing present methods of locomotive use and determining what steps must be taken (1) to reduce the time that locomotives are at terminals; (2) to increase the time they spend earning revenue in road service, and (3) to assure the co-operative effort of all departments, without which these objectives can never be attained.

Horsepower Capacity At High Speed

The report of the Mechanical Division tests to determine the maximum drawbar horsepower required to operate a 1,000-ton passenger train at 100 m. p. h. on level tangent track, an abstract of which appears elsewhere in this issue, presents a wealth of data pertaining to the operation of high-speed passenger trains which merit the careful study of every engineer who has anything to do with locomotive design or passenger-train performance.

One point in the report merits particular attention. In the study of the rates of acceleration based on a set of calculated drawbar horsepower curves, the maximum drawbar horsepower of the entire set of curves, ranging from 3,000 to 7,000 hp. is calculated at approximately 40 m. p. h. This is an extremely low speed at which to reach maximum drawbar capacity in modern steam locomotives designed for high-speed service. The maximum drawbar horsepower of the New York Central J-3 Class 4-6-4 type locomotives, for instance, occurs at 65 m. p. h. A locomotive develops a decidedly higher proportion of its maximum capacity at 90 or 100 m. p. h. if its maximum horsepower capacity is attained at 65 m. p. h. than one which reaches its capacity at 40 m. p. h.

A comparison of these drawbar horsepower curves with that of the New York Central J-3 class 4-6-4 type locomotive, shown on page 173 of the May, 1938, issue of the *Railway Mechanical Engineer,* indicates a con-

siderably different performance during acceleration by the two locomotives of similar maximum capacity. The 4,000-hp. locomotive, which reaches its maximum drawbar output at 40 m. p. h., has greater high-speed acceleration rates up to approximately 55 m. p. h. and less at higher speeds. Hauling a 1,000-ton train, the two locomotives will have reached the same speed of approximately 70 m. p. h. in about five minutes. From that time on the speed of the locomotive which develops its maximum capacity at 65 m. p. h. will accelerate at a higher rate than the other. In about ten minutes it will have accelerated to 90 m. p. h. and will have overtaken and passed the other in point of distance traveled. It will have a balancing speed with a train of this weight of about 5 m. p. h. higher than the other locomotive, even though its maximum horsepower is only 3,880 and the other is 4,000.

From the standpoint of high-speed, high-capacity performance, it is, therefore, evident that it is not alone the maximum horsepower capacity of the locomotive which is important, but also the speed at which it can be utilized. In the final analysis the speed at which maximum capacity is reached depends upon cylinder performance, and as the speed at which maximum drawbar horsepower is reached becomes higher, the demands on the cylinders become increasingly severe because of the accelerating rate at which head-end resistance uses up cylinder horsepower. The speed range within which an increasing cylinder horsepower may be obtained is limited, in part at least, by the difficulty of getting steam into and out of the cylinders at high piston speeds. Improvement at this point would do much for the future of the steam locomotive as a high-capacity, high-speed motive-power unit.

Value of Free Oil?

At the March meeting of the Northwest Carmen's Association, the subject of waste reclamation and general lubrication practice for freight equipment was presented at some length. In the discussion following the main paper, it is interesting to note that, in response to the suggestion that the addition of free oil does little good except when of a lighter grade, one member said, "As I understand it, the main objection to free oiling is that it cannot be supervised. From my standpoint, I feel that every box packer is interested enough in getting cars to destination so that he does not overload the boxes. Further, I feel that, with certain grades of packing, the free oil does a great deal of good in the initial 25 miles of operation after cars have stood for some time at a terminal. I do not mean that free oil should be applied without proper spooning of the box, but I mean that with proper supervision good results have been achieved. I would not say that the cut-back oil disappears from the packing, but it has a tendency to mix with the other oil in the packing and I feel that the box is in a better condition when given to someone else, than it was when originally received. I do not believe every journal should receive free oil, but if we have 20 cars in a train which need journal attention, it is beyond human effort to repack these journal boxes before the train is ready to depart."

This comment by one of the speakers at the Northwest Carmen's meeting is worth consideration as having a very definite bearing on the satisfactory use of free oil in journal boxes. While primarily applied to facilitate train starting under severe winter temperatures, the light oil remains in the boxes during summer operation and consequently presents more or less of a year-round problem to car men. Two questions are suggested: Should the practice of free oiling be permitted at any time? If permitted, is it necessary to repack the boxes in order to assure adequate oil film strength for summer operation?

New Books

LOCOMOTIVE MANAGEMENT—CLEANING—DRIVING—MAINTENANCE.—*Seventh edition. Revised by Chas. S. Lake, M. I. Mech. E., M. I. Locomotive E. Published by the St. Margaret's Technical Press Limited, 33 Tothill street, Westminster, London, S.W. 1, England. 492 pages, 5 in. by 8½ in. Price, 6/–, net.*

Much of the text in this seventh edition of Locomotive Management, by Jas. T. Hodgson, M. I. Mech Eng., and the late John Williams, formerly locomotive inspector, Great Central Railway, has been rewritten and much new data, with illustrations, added. Booster engines, boiler fittings of various kinds, anti-friction bearings for axle boxes and valve motions, and other improved features pertaining to British locomotive design, construction, operation and maintenance, are dealt with for the first time in this volume. Types and classes of locomotives introduced since the last edition are also shown and their principal dimensions given. The chapters on rules and regulations governing the operation of locomotives have been brought up to date, and the appendix has been considerably altered to include descriptive matter and illustrations of special equipment and outline drawings of locomotives giving their principal overall dimensions, weights, etc.

DIESEL ENGINES, THEORY AND DESIGN. *By Howard E. Degler, M.E., M.S., professor of Mechanical Engineering and Chairman of the Department, University of Texas. Published by the American Technical Society, Chicago. 270 pages, 5½ in. by 8½ in., illustrated. Price, $2.50.*

The book is a practical text on the efficiency of internal-combustion engines; thermodynamics of internal-combustion cycles; fuels, combustion, and combustion chambers: testing and performance; principles of engine design, and design of major engine parts as used in the automobile, airplane, tractor, etc. It is intended primarily for the use of students, designers, and draftsmen who have a knowledge of the principles of mechanics and a general acquaintance with the mechanism of some form of internal-combustion engine.

With the Car Foremen and Inspectors

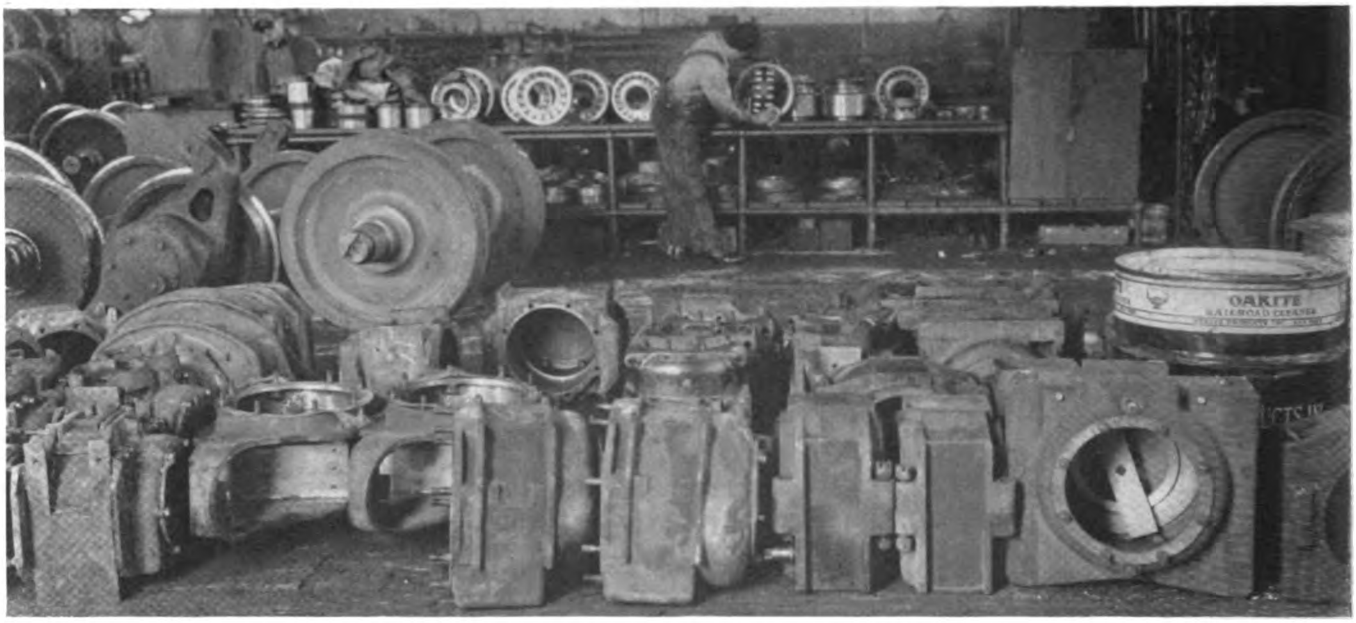


Fig. 1—Roller-bearing repair department in the U. P. passenger truck shop at Omaha, Neb.

Omaha Shop Methods for

Roller-Bearing Repairs

WITH the increasing number of roller bearings applied to the journals of both locomotive and car equipment in recent years, the importance of developing proper methods of inspecting and maintaining these anti-friction bearings is at once apparent. The present article will be confined primarily to a brief description of how the roller bearings on passenger car journals are reconditioned at the Union Pacific passenger car truck shop, Omaha, Neb.

When trucks received at the shop are in need of general repairs, including wheel changes due to tire wear, thin flanges, etc., the wheels, with roller-bearing boxes in place, are removed and placed with the shop crane on a track in one corner of the shop where the work on roller-bearing wheels and journal boxes is concentrated.

The first operation is to remove the inner enclosure bolts and slide the housings off the roller bearings. The housings, or journal boxes, are cleaned in a hot bath of Oakite solution in a tank outside the shop, then being returned to the shop, wiped dry and carefully inspected inside and out for evidence of cracks, or defects of any kind, which would necessitate renewal of the box. A circular gage, made of thin sheet steel, ground to the exact outside diameter of the roller-bearing cup, is then applied in the box to check the accuracy of the cup bearing surface. This is highly important, as more than one instance of excessive heating of a roller bearing has been traced to a slight distortion in the steel box due to aging, or other cause. A group of roller-bearing boxes, or housings, as they are more accurately termed, is shown in the foreground of Fig. 1, after they have been thoroughly cleaned, inspected and approved for re-application.

Removal of the locking key and large end nut used with the SKF-type bearing usually enables the complete roller-bearing unit to be slipped off the journal. In the case of the Timken bearing the taper sleeve under the outer cone must be pulled out by mechanical power, generally applied by means of a special split sleeve and pulling nut. The outer cone and the double cup are then removed and, in conventional practice, the enclosure, enclosure sleeve and the inner cone are forced off when the car wheel is removed in the wheel press.

Roller Bearing Puller Saves Time

A special roller-bearing puller, now used in removing both the outer and the inner cones of Timken roller bearings at Omaha shops, not only reduces manual labor and saves time in this operation, but avoids the necessity of pressing off the wheel in order to remove the inner cone. An excellent view of this device, set up to pull the taper sleeve which releases the outer cone, is shown

in Fig. 2, and a reverse view with attachments necessary for pulling the enclosure, enclosure sleeve and inner cone is shown in Fig. 3.

Referring to Fig. 2, the puller will be seen to consist essentially of a Duff-Norton 100-ton air jack, mounted horizontally between two heavy steel end plates *A B* bolted (through suitable welded cross angles) to bottom tie plates *T T* which can be adjusted vertically a small amount by screw connection to the frame *F* of the three-cone to be removed by the puller, equipped with another special split yoke *D*, as shown in Fig. 3. In this instance the split yoke, 4½ in. wide by 19 in. in outside diameter, is made in two parts which are recessed on the interior so that it can be readily applied around the enclosure plate and the two halves bolted together by four short ⅞-in. bolts. Four 1¼-in. by 18-in. studs are screwed into the split yoke and extend through suitable holes in end plate *B*, spacing collars and nuts being

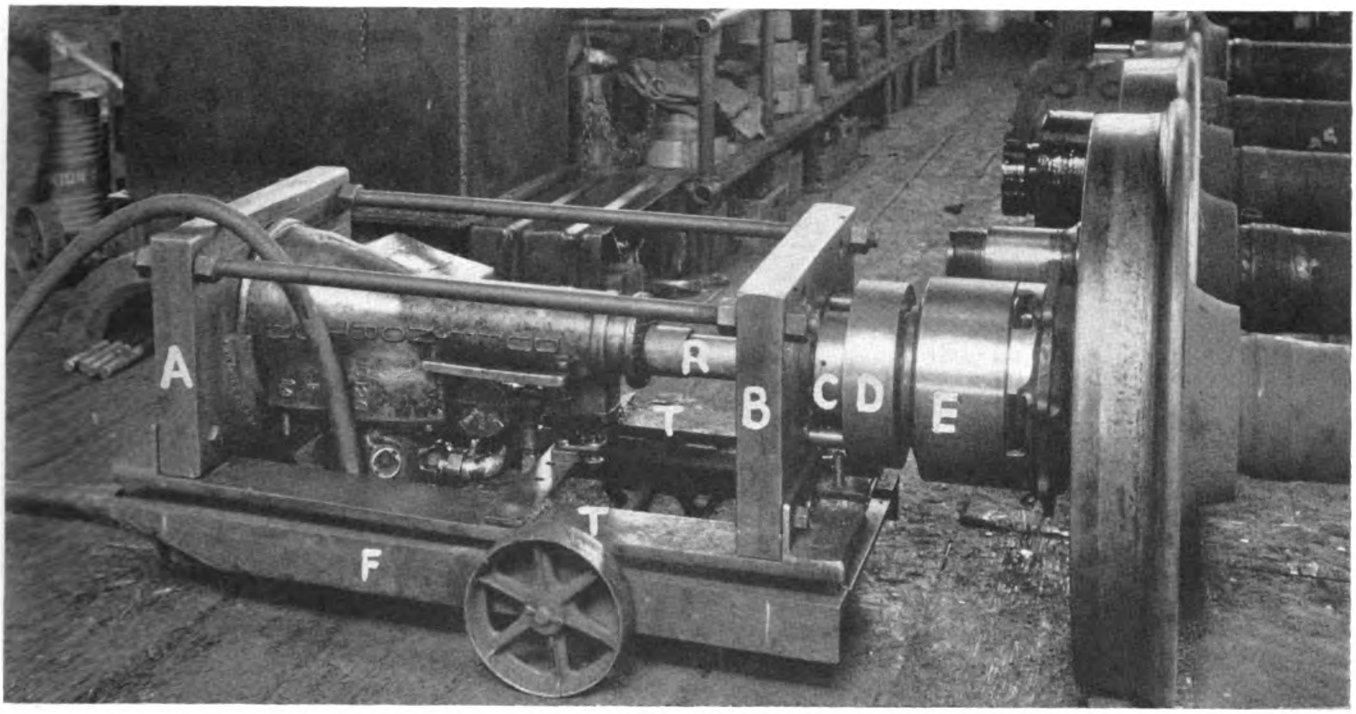


Fig. 2 — Roller-bearing puller, set up to remove the Timken taper sleeve which releases the outer cone and the double cup

wheel truck provided for purposes of easy portability. The end plates, 3 in. by 16 in. by 24 in., are spaced 42 in. apart and held together at the top by two 1¼-in. tie rods. The base of the jack is supported on a half-round flange welded to end plate *A*, as shown, the other support for the jack being a cross strap, welded to tie bars *T T*. The jack head is lightly bolted to this cross strap so as to hold the jack permanently in the correct horizontal position. The end plate *B* has a 3-in. hole in the center which carries a close-fitting round steel ram *R*, about 15 in. long, used in transmitting the pressure of the jack to the end of the car axle.

This horizontal-acting air-jack press must, of course, be adjusted vertically by means of the positioning screws to bring the center line of the ram in exact alinement with the center line of the axle. A threaded split bushing *C*, 5½ in. long by 8 in. in outside diameter, is then applied over the shoulder on the roller-bearing sleeve and locked by means of pulling nut *D*, 3 in. wide by 12 in. in diameter, which is tightened with a spanner wrench. The nut *D* is drilled and tapped on the side for two 1¼-in. by 8-in. studs which project through end plate *B* and are held by suitable nuts applied on the ends. The operation of the air jack, therefore, has the effect of pushing against the end of the axle while the entire pulling device, including the end plate *B*, split bushing *C* and holding nut *D* move to the left, pulling the Timken taper sleeve out and releasing the outer cone. The Timken double cup *E* can then also be easily slipped off by hand.

The removal of the outer cone and the double cup then leaves the enclosure, enclosure sleeve and the inner applied on the ends in preparation for the pulling operation, as illustrated. With the press adjusted both horizontally and vertically so that ram *R* is in alinement with the center line of the car axle, operation of the air jack again has the effect of pushing against the end of the car axle while end plate *B* split yoke *D*, the enclosure, enclosure sleeve and inner cone are being pulled from axle.

By the use of the puller, illustrated, both cones of the Timken roller-bearing unit can be removed much quicker than by any other means, and with manual labor reduced to a minimum.

The Operations of Cleaning and Inspecting

As soon as the roller bearings have been removed and disassembled, they are taken to the cleaning table shown in Fig. 4, where two shallow welded-steel pans are provided for the cleaning operation which is done with distillate. Obviously-defective bearings are detected in the early stages of cleaning and sent to the test department where complete records are kept and an effort is made to determine the real cause of the failure and locate the responsibility.

After cleaning, all roller bearings are sent to the inspection bench, shown in the background of Fig. 1, where the cups, cones, races and all individual rollers are examined with great care. In the case of the SKF-type bearing, the roller assembly can be turned through 90 deg., exposing almost the entire outer race for inspection purposes. The tapered rollers in the Timken bearings are readily removable in case their appearance indicates the desirability of a careful inspection of the races. Roller

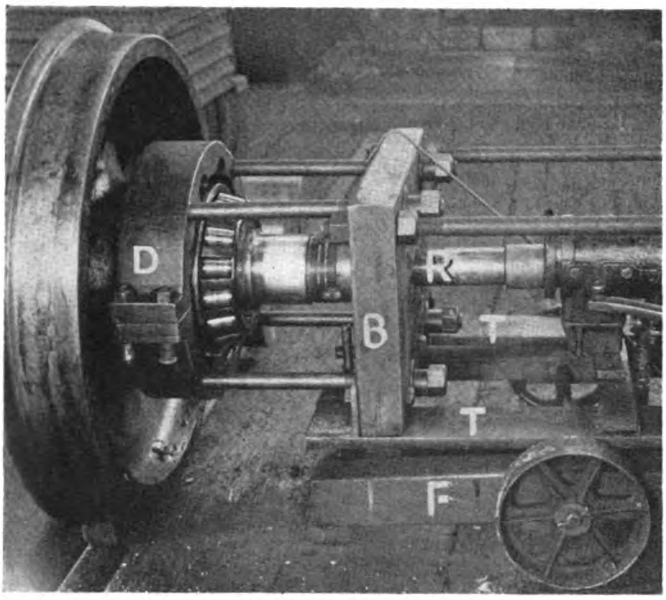


Fig. 3 — Close-up view showing the puller, as equipped to remove the Timken inner cone without pressing off the car wheel

bearings which are in good condition are set aside for reapplication and all defective units replaced by new ones received from the respective manufacturers.

In re-applying SKF-type roller bearings, the dust flinger is put on over the axle next to the hub; the back cover of the box is next applied and the spacer shrunk on by heating to 300 deg. F. in an oil bath which is kept exactly at that temperature, with frequent checks by a thermometer. In some applications, as for instance the engine truck roller bearings shown in Fig. 5, the roller bearing unit itself is heated in the oil bath to 300 deg. F. and applied over the journal with a very light shrink fit. In most instances, with car journals, however, the roller bearing is applied on the journal and a taper sleeve inserted which is tightened by means of the end nut on

Fig. 4 — Welded steel table and shallow pans used in cleaning all types of roller bearings with distillate

the axle until the desired clearance of 0.0025 in. to 0.0004 in. is provided between the bottom roller and the outer race. The nut is locked in this position by means of a key and two cap screws with the heads wired together. The journal box or housing is then slipped over the roller bearing, with new gaskets in place, the front and back covers applied, nuts tightened on the studs and the box filled with oil to the proper level.

Re-application in the case of the Timken bearings consists of starting the water guard on its seat on the enclosure and placing the enclosure next to the wheel hub on the axle, the bore of the enclosure sleeve being given a coat of clean light oil, as is the bore of the inner cone, next applied. A crowned steel centering plate and cast iron assembly sleeve, guided by a brass pilot sleeve on the outer end of the axle are then applied and the press ram used to force the inner Timken cone and associated parts on with a pressure of 8 to 10 tons. The pilot sleeve is very slightly smaller than the bearing bore and a loose fit on the axle stub. The assembly sleeve is a loose fit on the bearing seat. The centering plate is crowned to equalize the pressure around the edge of the cone, which

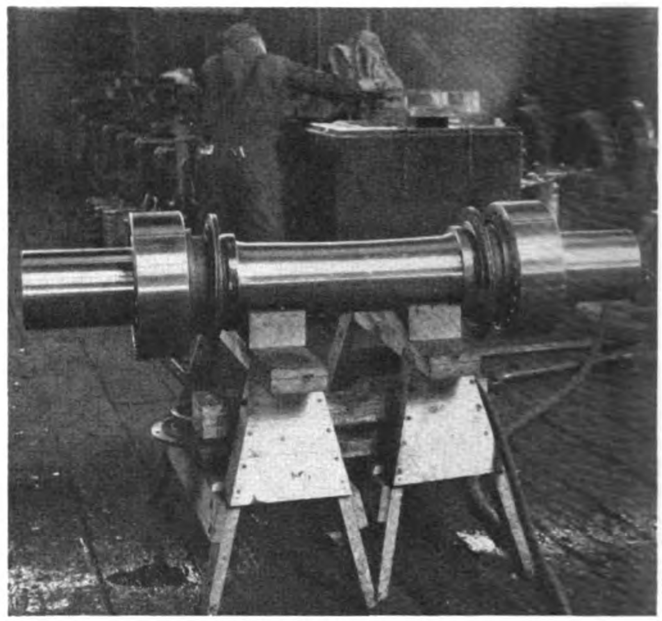


Fig. 5 — Engine truck axle just after the application of SKF roller bearings which have been expanded slightly in the 300-deg. F. oil bath shown in the background

is seated firmly against the shoulder of the axle and square with the bearing seat so that it runs true with the center line of the axle.

The next operation is to apply shims, cone spacer, double cup, outer cone, tapered sleeve and then tighten the axle nut firmly, by hand only. Both the inside and outside of the tapered sleeve is given a coating of clean light oil before being put in place. The lower edge of the cup is then pushed toward the wheel by hand as far as it will go and the clearance measured between the bottom roll and the outer race of the cup by means of feeler gages. The shims are changed until about 0.007-in. clearance is obtained between the bottom rolls and the cup. The diameter of the outer cone is measured with micrometer calipers and the nut tightened so as to expand the cone between 0.0015 in. and 0.0035 in. The remaining clearance at the bottom of the rolls is then checked and adjustments made until it is between 0.0015 in. and 0.0020 in., the cup then rotating freely by hand without noticeable end play. Care is taken in measuring

the cone expansion to apply the micrometer at the same two spots on the cone rib for each reading. The axle nut is locked in place by a fastening key with two bolts, the heads of which are wired sealed.

The housing is applied over the bearing and the enclosure gasket placed between the box and the enclosure flange, all bolts being tightened. The outer cover and gasket are then applied and all bolts tightened enough to prevent leakage of oil, the heads being wire-laced so that they cannot loosen or work off. The water guard is pressed firmly against the wheel hub with a bar, until it has a full bearing all around. One quart of oil is added to the box which is spun through several revolutions to make sure that all parts of the roller bearing are thoroughly lubricated. The car wheels and axle, with a reconditioned roller bearing and box on each journal are then ready for replacement in the passenger car truck. The last operation is to fill each box to the required level with U. P. specification oil, tighten the oil plug and make sure that both this plug and the drain plug are wire sealed to the nearest bolt head to prevent any possibility of loosening.

Wheel Defects and Failures*

By P. J. Hogan†

The relation of car wheels to railroad economics is one of the most important subjects in the mechanical department and large sums of money are expended annually for the purchase of wheels, payment for labor involved in handling, machining, mounting axles and applying the mounted wheels to cars. Other sums are spent indirectly for inspection on shop tracks and in train yards, switching of equipment for wheel changes, freight claims due to wheel failures which cause delay, thereby missing regular schedules, and damage to equipment and commodity when they are the cause of train accidents. Wheel failures, in addition to contributing to these losses, endanger human life as well.

The car inspector is the custodian of wheels from the time they are placed under cars until they are removed for cause and returned to the wheel shop. It is amazing how quickly he will detect unsafe wheels. His early training in the shop and on the repair tracks and his continual vigilance over them in train yards, together with the use of the A. A. R. wheel defect gage, gives him the necessary qualifications quickly to pass proper judgment as to whether or not the wheel is safe to run.

It is his duty carefully to inspect all wheels for looseness on the axle, limits of wear as required by the A. A. R. rules and all other defects which affect safety.

The A. A. R. rules do not permit railroads to remove from foreign cars and render a bill for any wheels until some defect has reached a definite condemning point and we must consider the wheel safe until that point is reached. When the condemning point is reached the wheel should be removed from service. However, it is no more than reasonable to assume that, if the wheel has only reached the limit point, it is still safe to let it run to the nearest point where it can be changed.

Inspection of wheels is one of the most particular and important jobs a car inspector has, for, if defective wheels were allowed to progress beyond the limits of safety, serious accidents would occur, and yet if they are removed before reaching the limits of wear, the cost to the railroads would be enormous; therefore, the car inspector has to study and know what the wheel defects are and must be on the alert to detect such defects under cars.

Many wheels have inherent defects and are not visible to the eye in ordinary or even in minute inspection, while other defects that exist do not present themselves where they can be readily seen. These classes of defects usually cause train accidents. Many defects develop in ordinary wear and tear, others progress by improper handling in train and yard operation, controlling speeds in mountainous sections of the country, causing wheels to overheat, defective brake equipment, curve-worn rails, worn frogs and other irregular track conditions, weather conditions, etc. These are but some of the causes for wheel defects and failures.

On the road I represent, records for the year 1938 indicate that we changed 7,041 pairs of wheels under freight cars for the following reasons:

Brake burns and comby treads	1,064
Chipped or broken flanges	364
Worn flanges	347
Loose wheels on axle or oil indications	92
Hub or plate cracks	57
Broken wheel rims	1,817
Seamy treads	1,314
Worn thru chill	1,001
Shelled out treads	175
Tread worn hollow	268
Thermal cracked	12
Wheels slid flat	530

During the same period we changed 3,598 pair of wrought- and cast-steel multiple-wear wheels under passenger cars for the following reasons:

Brake burns	2
Chipped or broken flanges	1
Worn flanges	1,879
Wheels loose on axle or oil indications	28
Burned rim	1
Shelled treads	185
Worn out rims	163
Tread worn hollow	574
Thermal cracked	97
Slid flat	573
Miscellaneous	95

I mention these tabulations to bring before you the efficiency of the car inspector in detecting these defective wheels and removing them before causing failure and possible accidents. In this connection, understand all of these wheels did not become defective on the New Haven—many of them were found upon receipt of cars from connections.

The inspector has to be sure of the condemnable or questionably defective wheel so as to avoid sending a foreign empty or loaded car to the repair track with the attendant per diem charges and possible delay to the commodity; accordingly, he should not hesitate to make use of the A. A. R. defect gage.

Defects in Freight-Car Wheels

In considering the defects on the 7,041 pairs of wheels removed from freight cars the following is a discussion of the causes:

* A paper presented at a meeting of the Eastern Car Foremen's Association, New York, April 14, 1939.
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Brake-Burn Cracks and Comby Treads—Interchange Rule 75 states that cast-iron wheels with comby spots where the metal has fallen out for a continuous length of 2½ in. or over, or two such adjoining spots each 2 in. or over, is condemnable. Brake-burn cracks in cast-iron wheels, when the cracks are in the flange or in the throat of the flange, or in the tread, when over 2¾ in. in length, are condemnable. These brake-burn transverse cracks, regardless of length, are considered as extending into the throat if they come within ⅞ in. from flange and may be determined now by the A. A. R. defect gage, Fig. 1-A. Comby wheels refers to a wheel in which the metal has fallen between the adjacent brake burn spots and, when of the condemning length, makes a comby flat wheel. Brake-burn cracks are a result of excessive heating caused by the brake shoe or by a skid burn; the chilled iron being unable to withstand the localized heating. This condition is dangerous when it is in the flange or throat of the flange. To cause this condition the temperature of the wheel is raised to about 1,400 deg. F. A comby wheel is not dangerous in itself but is damaging to car, lading and track.

Chipped or Broken Flanges—These were caused by contact with guard rails, spring frogs, and other obstructions. Rule 78 provides that the wheel is condemnable when the chip is more than 1½ in. in length and ½ in. wide; such flanges are liable to cause further failure. However, light chips on the flange are not dangerous and such wheels should not be changed.

Thin Worn Flanges—Rule 75 provides limits of wear. Thin worn flanges are measured by the defect gage. This gage has two slots for measuring the flange thickness; one is marked 15/16 in. and is used to condemn flanges on cast-iron wheels under cars of less than 80,000 lb. capacity and all wheels, cast-steel or wrought-steel, regardless of car capacity. The 1-in. slot is used on cast-iron wheels under cars of 80,000-lb. capacity and over.

The vertical worn flange is in no way dangerous except that it may split a switch, otherwise it is perfectly safe to operate. To break a flange on a single-plate cast-iron wheel worn to the condemning limit, takes a pressure of about 66,000 lb. Derailments should not be chargeable to a worn vertical or thin flange unless it has split a switch.

Loose on Axle—For wheels listed as loose on the axle or indicating oil leakage to the inside of the wheel, Rule 81 makes the car owner responsible, except in the case of oil seepage if the wheel is removed within one year from the date of application. To the car inspector, loose-wheel indications are generally oil working through the wheel fit; bright wear on the axle at the wheel fit or the breaking away of the paint seal at this location; a fine burr on the inside of the wheel hub at the wheel fit and distinct marks on the flange by guard rail and frog contacts. This defect will also cause a hot box by wheel crowding. Poor shop practice in wheel mounting is usually the cause of this defect.

Hub and Plate Cracks—Rules 77 and 78. The car inspector's trained eye detects these defects which sometimes show up as a loose wheel when in the hub, and when in the plate they open up considerably with the running heat of the wheel. When the wheel is cold it contracts and the cracks close up tight, consequently the defect cannot be seen. These defects have to be carefully watched on account of liability of failure. The cause of such failures is usually due to foundry practices but they are also chargeable to train handling under certain conditions.

Broken Rims—Rule 78 provides a limit distance from the flange of 3¾ in. for breaks which slope inwardly and a limit of 3½ in. for those which are vertical or slope outwardly. This is a defect that requires proper gaging to prevent unnecessary car shopping. The cause of broken rims is primarily curve-worn rails and wheel-worn frogs, and most of these failures take place on freight railroads where tracks are not maintained for high speed. The outer portion of the tread of cast-iron wheels is not ductile enough to withstand all shocks received on the low rail at times when the opposite wheel is crowded against the curve-worn ball of the rail. Similar breakage occurs also at times when the wheels are passing through worn frogs, and I might mention that there are certain kinds of frogs which have a tendency to damage the wheel rim.

Seamy Treads—Seams defined in Rule 72 are dangerous and should be removed from service upon discovery when they are within the limits of 3¾ in. from flange. Inspectors should take special precautions to discover any indication of seams as they may develop in different parts of the treads.

Worn Through Chill.—Rule 73 provides that care must be taken to distinguish this defect from flat spots caused by sliding, on account of the divided responsibility. This defect is now condemnable by judgment. When developed it leaves a low or flat spot on the wheel tread. It may be determined by drawing a straight-edge over the suspected area which will leave a bow on the outer edge of wheel rim if the chill is worn. In detecting wheels that are wearing through the chill, the inspector discovers the chill lines breaking down and the rim taking a curve line near the outside. He also discovers the flange height increasing. The defect is due to low chill and when the white metal is worn through, the grey soft metal flattens out. It is a manufacturing defect.

Shelled-Out Treads—Rule 71 provides that cast-iron or cast-steel wheels with a shelled-out spot 2½ in. in length or over should be removed from service. This defect is measured circumferentially and not across the tread. It is distinguished from the comby spot by the high center and should be properly named on shop and billing records. Shell-out wheels are not considered dangerous from the viewpoint of wheel safety but they are liable to cause track, car and lading damage.

Tread Worn Hollow—Rule 76 defines the use of the gage for the condemning of cast-iron and one-wear cast-steel wheels when the projection on the under side of this gage clears the wheel tread the flange has exceeded 1 7/16 in. in height. When the wheel has actually worn to this limit it should be removed as the deep flange is liable to strike the base of frogs and break up.

Thermal Cracks in Tread—Rule 75 provides that such cracks, if in the flange, the throat of the flange or, when in the tread, are over 2¾ in. in length are condemnable. Thermal cracks invariably run at right angles to the tread of a wheel. They are caused by brake-shoe pressure being applied for such a period that the temperature of the tread is raised to about 1,400 deg. F. A stuck air brake or a hand brake set up could cause this condition in a distance of about a half mile. These defects are dangerous when in the flange or throat of the flange. Wheels showing red discoloration should be carefully checked for cracks of this kind.

Slid Flat Wheels—Rule 68 provides that slid flat wheels must not be removed until one spot at least has reached 2½ in. or two adjoining spots each 2 in. in length. These flat spots must be considered as running circumferentially with the tread. When the two adjoining flat spots have developed they must be in contact with each other. The sliding of wheels, in addition to being costly, is very troublesome in train opera-

tion. When wheels slide the co-efficient of friction between the brake shoe and the wheel is greater than that between the wheel and the rail. There are many things which cause wheel sliding. For example, when wheels are out-of-round high speeds reduce the wheel contact weight on the rail and at a critical moment a brake application will slide the wheel. Other causes are wet and greasy rails, improper handling of air brakes, hand brakes set up, shoes frozen to wheels, and wheel and rail head contour variations. In many cases, as a slid flat spot increases in length the friction between the wheel and the rail increases, overcoming that between the wheel and the brake shoe; therefore, the wheel revolves again. In other cases the wheel slides again on the same spot which increases in length and the wheel will continue to slide. To flatten a wheel the temperature has to be raised by friction to about 2,000 deg. F. A 1-in. flat spot develops in a very short distance, depending on the wheel weight and the rail conditions. In many instances only one wheel on the same axle will flatten due to the same cause.

Passenger-Train Wheel Defects

In the case of wrought-steel and multiple-wear cast-steel wheels 3,598 pairs were removed from passenger-train cars. A discussion of the reasons follows:

Brake-Burn Thermal Cracked.—Passenger Rule 7 provides that cast-steel, wrought-steel or steel-tired wheels with thermal cracks in the tread or flange, regardless of length, are condemnable. These cracks are caused by intensive brake-shoe heating; thus, when the heat is sufficiently high and concentrated in the tread surface transverse cracks develop; a brake shoe riding the wheel rim or bearing hard on the flange will cause such defects. They are serious as there is no means of determining the magnitude of the strain in the wheel structure. Inspectors must keep a constant watch for rim heating and all cracks on wheel treads.

Chipped or Broken Flange.—This defect is caused by guard rail and frog contact, also by other obstructions. It also denotes a wheel loose on the axle and a careful check should be made.

Worn Flanges.—Rule 7 provides that wrought-steel, steel-tired or cast-steel wheels with a flange $^{15}\!/_{16}$ in. thick or less, or having a flat vertical surface extending 1 in. or more from the tread, are condemnable. The thickness of worn flanges is determined by the wheel defect gage and it should be properly applied in accordance with Fig. 3 of the Freight Code. Vertical worn flanges are hard to find if properly gaged. The flange should be chalked on the gage side with the end of the gage resting on the wheel tread and the side of the gage against the flange. With a slight movement back and forth the chalk will appear on the bearing point—if the 1 in. point is not reached, the wheel should remain in service.

Wheels Loose on Axle or Oil Seepage.—This defect has been explained under the freight-car wheel removal.

Burned Rim.—This type of defect leaves a rough granular surface on the break, and is generally caused by overheating in the course of manufacture.

Shelled Treads—If the surface metal breaks down, spalls or flakes, it is termed a shelled tread. A cut, to a depth of ⅜ in., should be taken to clear up this defect. If more than ⅜ in. deep, it should be protected and further investigated for other termed defects. We have had only a few that could not be turned.

The 95 wheels removed for miscellaneous causes were for defects found principally in the turning of wheels in the shop.

The above defects, most of which were discovered by the car inspector, further proves that his watchfulness over these wheels has borne fruit in preventing wheel failures. In addition to the A. A. R. defect gage, an inspector must be familiar with other wheel gages to know that wheels are of the proper gage on the axles and to detect tread wear.

The car repairer on the repair and shop tracks selects the mounted wheels for use under cars, checks them for proper weight and kind, takes records for billing purposes, marks up the defects and the symbol numbers on the wheels for ready identification, services the journals and the boxes and sends them on their way. All wheels receive final inspection at the wheel shop.

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

426—*Q.—What improvement may be noted for this equipment insofar as brake cylinder pressure is concerned?* A.—Due to the automatic self-lapping feature of relay valves, the brake cylinder pressure developed for a given brake pipe reduction is not affected by varying brake cylinder piston travel or normal brake cylinder leakage.

427—*Q.—How does the D-22-A valve compare in size to the old type?* A.—It is smaller.

428—*Q.—For what reason is the installation space less?* A.—By reason of combining in one structure the volume of emergency, auxiliary and displacement reservoir.

429—*Q.—What conversion feature is of great benefit?* A.—The high-speed conversion feature. The D-22-A valve is so designed that by adding additional available devices to the equipment it can readily be adapted for electro-pneumatic operation with a speed governor or Decelakron control for ultra high-speed service.

430—*Q.—What parts make up the complete D-22-A control valve equipment on a passenger equipment car?* A.—

Quantity	Name
1	D-22-A control valve
1	Combined dirt collector and cut-out cock
3	Branch pipe tees
2	B-3-B conductor's valves
2	E-3 brake application valves
1	Retaining valve
1	Combined auxiliary, emergency and displacement reservoir
1 (or more)	Supply reservoir with drain cock
As required	Relay valve, Type B or A-4-A
As required	Type U brake cylinders
As required	Slack adjusters
As required	Brake cylinder cut-out cocks
As required	Armored hose for brake-cylinder pipes
2	1¼-angle cocks
2	1⅜-in. hose with couplings
2	F dummy couplings

431—*Q.—What does the D-22-A control valve consist of?* A.—Two face pipe brackets, service portion and emergency portion.

432—*Q.—How does the pipe bracket function?* A.—It is bolted to the under framing, all pipe connections being made permanently to the bracket by means of re-

enforced flanged unions. The service and emergency portions are bolted to the bracket.

433—*Q.—What is a desirable feature in connection with this arrangement?* A.—No pipe joints need be disturbed when removing or replacing portions.

434—*Q.—What is the duty of the service portion?* A.—It controls the desired charging of reservoirs and the service application and releases the brakes.

435—*Q.—What improvement can be noted?* A.—Improved quick service transmission, release insuring and graduated release features.

436—*Q.—What is the duty of the emergency portion?* A.—It controls the quick action feature, high emergency brake cylinder pressure, and the accelerated emergency release function.

437—*Q.—What improvement may be noted?* A.—Improved emergency transmission and accelerated release after emergency application.

438—*Q.—What does the pipe bracket contain?* A.—The quick-action chamber, a removable hair strainer and two choke plugs; the latter being located in the service portion face.

439—*Q.—What is the size of the plug opening?* A.—The size choke in each plug varies with the brake cylinder size.

440—*Q.—Why is this?* A.—To provide uniform operation of brakes in train service regardless of the number of sizes of brake cylinders or individual cars.

441—*Q.—What are these plugs called?* A.—Exhaust choke plugs and service port choke plugs.

442—*Q.—What other pipe connections does the pipe bracket have?* A.—The necessary pipe connections for later conversion to high-speed conversion feature.

443—*Q.—How is the blanking flange arranged?* A.—For replacement with a suitable double check valve for HSC service.

444—*Q.—What is meant by the high-speed conversion feature?* A.—By adding additional devices to the equipment it is readily adapted for electro-pneumatic operation with speed governor or Decelakron control for ultra high-speed service, as on light-weight streamline trains.

445—*Q.—Name the parts of the service portion?* A.—Service piston, service graduating valve, service slide valve, service piston return spring and cage, piston tail spring and guides, supply reservoir charging check and ball check, emergency reservoir charging check and ball check, back flow check and ball check, release piston and slide valve, quick service choke plug, duplex release valve, quick service volume, preliminary quick service exhaust choke plug, graduated release choke and quick service limiting portion.

446—*Q.—What is the duty of the service piston?* A.—It moves the service graduating and slide valves when the brake pipe pressure is varied and controls charging of supply, auxiliary and emergency reservoirs from the brake pipe.

447—*Q.—What is the duty of the service graduating valve?* A.—It opens and closes the passage between: (1) Auxiliary reservoir and the chamber on the face of the release piston in release position, or between this chamber and the atmosphere with the slide valve in application position. (2) Atmosphere and quick-service volume in release position, or between this volume and the brake pipe with the graduating valve in preliminary quick service position and (3) Auxiliary reservoir and displacement reservoir with the slide valve in service position.

448—*Q.—For what purpose are the piston tail springs and guides?* A.—To provide stability of quick service activity by preventing movement of the service piston to preliminary quick service position until a predetermined difference is attained between the brake pipe and the auxiliary reservoir and to stabilize against movement to preliminary quick service during the graduated release operation.

449—*Q.—What is the purpose of the supply reservoir charging and ball check?* A.—To permit charging flow to supply reservoir from the auxiliary and prevent back flow.

Brake-Beam Skid

The light, but well-braced, tubular steel brake-beam skid, shown in the illustration, is a design recently developed and used with considerable success at the Union Pacific passenger car truck shop, Omaha, Neb. This brake-beam skid, or rack, is constructed of 2¼-in. scrap boiler tubes, cut to the proper length and shape and welded into a rigid one-piece frame, as illustrated, using the oxy-acetylene welding torch.

The skid is 56 in. long by 37 in. wide, with corner posts 24 in. high. The tubular frame of the skid is suitably stiffened by the addition of one extra tube, 16 in. above the floor, in each end and two center cross tubes, as illustrated, also by one diagonal tube, or brace, at each corner post. The corner posts rest on ½-in. by 3-in. by 5-in. steel shoes to give a larger bearing surface on the shop floor. The tops of the corner posts are capped with steel plugs, driven into a shoulder and used

Light but strong brake-beam skid used in the Union Pacific passenger car truck shop at Omaha, Neb.

to prevent stacking these skids to a point which might be dangerous. All tube joints are machined either square or to the necessary angle in a lathe, using a rosebit reamer, thus assuring a good fit of the parts before welding.

By being piled in an orderly manner on this skid, the brake beams are easier and safer to handle and there is no chance of their sliding off on the floor, with possible injury to shop men who are handling them. The skid, illustrated, has a capacity for 14 passenger truck brake beams, loaded two deep, or more than enough for a single passenger car. In other words, the skid can be used to hold a full set of brake beams, as removed from two trucks, easily transferred with a lift truck to that part of the shop where necessary repairs are made, and returned with minimum manual labor in handling. The illustration shows an unloaded skid in the foreground and a loaded skid with the lift truck in place immediately adjacent to it.

Railroad Shop Work Requires

Precision Gages*

By J. H. Hahn†

ONE of the most important precision measuring instruments in common use in the United States is the micrometer caliper; in fact, no other precision instrument has been so universally used. History tells us that the micrometer, like many other important inventions, is the product of many minds and hands and has been developed to its present stage by gradual evolution. Evidence now available shows that a French inventor and machinist by the name of Jena Laureut Palmer is given the credit for the origin of the micrometer caliper. Palmer obtained a patent on his "screw caliper," as it was called, on September 7, 1848. The trade did not seem to appreciate this tool until 1867, when it was seen by Joseph R. Brown and Lucian Sharpe while on a visit to the Paris Exposition of that year. The micrometer caliper was placed on the market in the United States in 1869, and is now generally used in most of the machine shops in this country.

The measuring instruments used in the machine shop at Roanoke are carefully checked and corrected, if necessary, at regular intervals to insure the greatest degree of accuracy. In addition to micrometers and steel scales, varying from one inch to twelve feet in length, there are many special measuring instruments in use in the form of gages, trams and special micrometers ranging in size from 1 to 80 in.

The class of work a shop turns out is governed largely by the accuracy of the measuring instruments used and Roanoke Shop is well equipped with all kinds of precision measuring instruments. In the manufacture of special gages and templates, two very efficient and interesting machines are usually employed. One of these

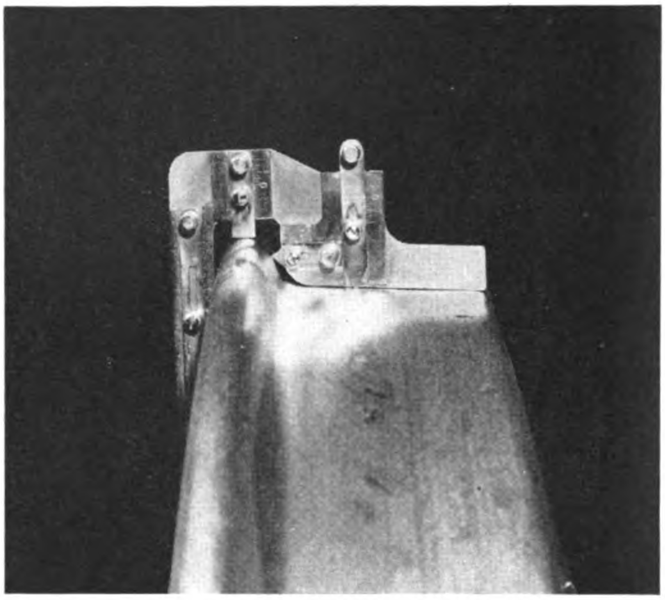

Fig. 1—Gage used for checking driving and trailer tires

* Reprinted, in part, from the Norfolk & Western Magazine.
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Fig. 2 (Left)—Nibbling machine used to make special gages and templates. Fig. 3 (Right)—Filing machine for finishing gages and templates

Fig. 4—Assortment of precision instruments and gages used in the tool room

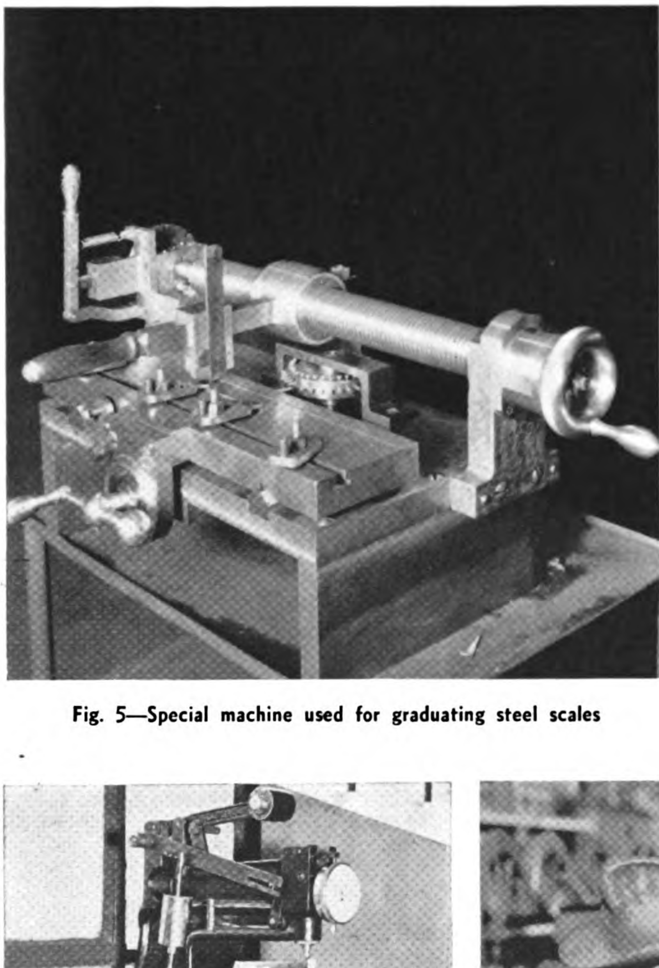


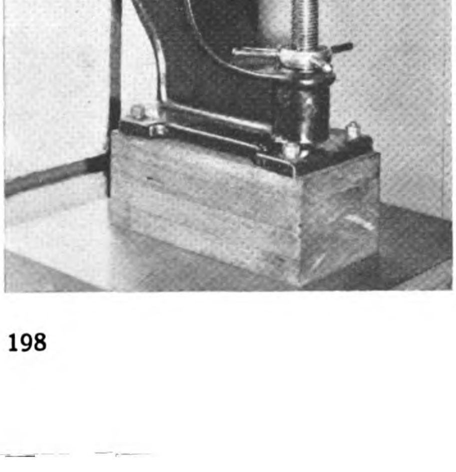
Fig. 5—Special machine used for graduating steel scales

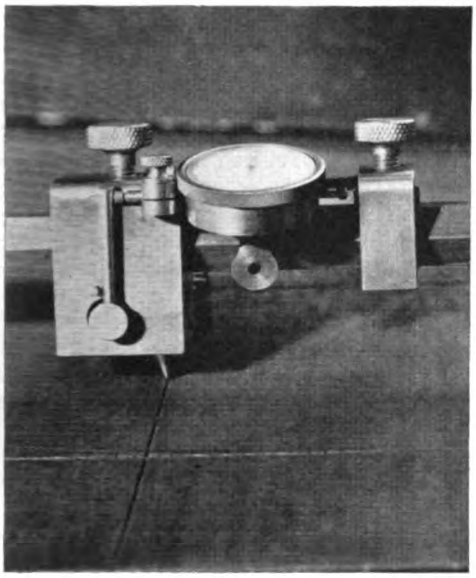
machines, known as a "nibbler," roughs out the gages within close limit of the finished dimensions. This machine is shown in Fig. 2. The semi-finished gages are then placed on a filing machine, shown in Fig. 3, where they are finished. The gages are sand blasted and some of them are chromium plated to protect them from rust.

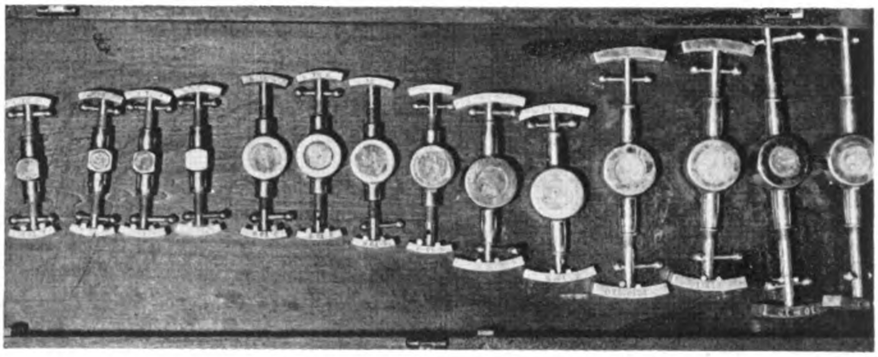
Fig. 4 shows a set of Johansson gages and other precision measuring instruments in use in the tool room of Roanoke shops for checking the accuracy of all gages, micrometers and other precision measuring instruments. These Johansson gages are the most accurate measuring devices that can be obtained for average shop use. The Johansson gages are accurate within one four-millionth part of an inch (.000004 in.) and are usually adjusted to size at a temperature of 68 deg. F. There are precision measuring instruments in the Bureau of Standards in Washington with which it is possible to measure with a greater degree of accuracy, but for general shop practice such a degree of accuracy is not considered practical or necessary. The Johansson gages can be assembled to form any required dimension. This is done in a very systematic manner and each gage must be absolutely free from any dust or foreign matter.

There are approximately 30,000 different items of

Fig. 6 (Below, left)—Rockwell machine for hardness testing. Fig. 7 (Below, right)—Gage for laying off the keyways in the main crank pins for the eccentric crank arms







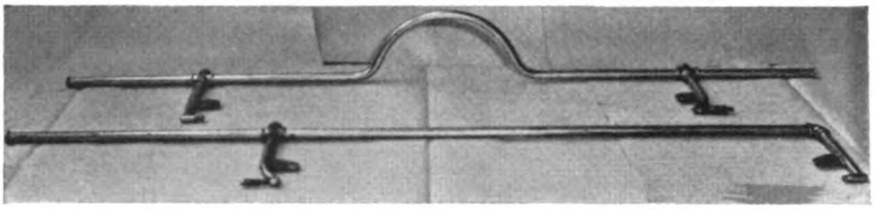


Fig. 8 (Left)—Special tram dial indicator. Fig. 9 (Top right)—Adjustable centers for checking the lengths of main and side rods. Fig. 10 (Lower right)—Micrometer calipers for measuring driving wheel tires

material manufactured annually in Roanoke shops in lots ranging from twelve to several thousand. These items differ greatly in material, design and size. Many require the design, manufacture and use of special gages, templates, jigs, fixtures, precision measuring instruments, check gages and trams to insure the greatest degree of accuracy during the process of manufacture. Everything possible is done to obtain the finest workmanship and the machine shop is well equipped with the necessary machine tools, precision measuring instruments and other facilities for handling the wide range of work that comes to this shop from all points on the road.

A number of special gages and measuring instruments require the use of steel scales of various lengths. These are graduated on a machine, shown in Fig. 5, which was designed and constructed by Norfolk & Western mechanics.

Internal and external thread gages are used for checking threads on all bolts, studs and other threaded parts. All nuts are checked in the same manner to insure proper fits between all threaded parts manufactured in Roanoke shops before being delivered to the stores department.

All trams used for tramming main and side rods, valve gear and other parts are checked at least once each week by a master tram bar for accuracy. A variety of gages are used in the grinding room where all drills, reamers, cutters and other hand and machine tools are ground and checked. Work of this kind is handled for the entire system.

With the discontinuance of the two-foot rule and the ordinary calipers as standard measuring instruments, we also discontinued the use of wood and lead centers in checking the lengths of main and side rods. These make-shift centers have been replaced by adjustable centers and a greater degree of accuracy is obtained by their use.

A number of gages and trams are used in fitting and assembling valve-motion parts, spring rigging and other parts. These gages are tested at regular intervals to insure the greatest degree of accuracy.

The use of special check gages and measuring devices increases the interchangeability of locomotive parts and this also leads toward standardization of many of the parts used in the construction and repair of various classes of locomotives and other equipment.

A special gage is used when mounting driving wheels to insure the crank pins being 90 deg. apart. After the wheels have been mounted with this gage the wheels are then placed in the quartering machine to test the accuracy of the workmanship.

A Rockwell hardness testing machine, shown in Fig. 7, is used for testing the hardness of all tools used in Roanoke shops. This applies to both hand and machine tools, taps, dies and all special tools manufactured in Roanoke shops for shipment to the outlying points.

Fig. 10 shows two pairs of 80-in. micrometer calipers used for checking the outside diameter of driving-wheel tires. The caliper shown in the upper part of the illustration is used for checking the diameter of tires while the wheels are in the driving-wheel tire-turning machine. The other caliper in the same view is used when checking the diameter of driving-wheel tires when the wheels are not in the lathe, or when checking unmounted driving-wheel tires. These calipers are designed to measure the outside diameter of driving wheel tires at a point 2⅝ in. from the outside face of the tire to insure all tires being exactly the same diameter. The stops that are welded on the arms of these calipers fit against the inside of the face of the tire, making it impossible to take the diameter of the tire at any other location than that shown on the drawing.

Fig. 1 shows a gage designed for use in enginehouses for securing certain measurements used in filling out monthly reports showing the condition of locomotives. This particular gage is used on driving-wheel, engine-truck and trailing-truck tires. Formerly four different gages were used. The gage shown takes the place of the four gages, as the thickness of the tires, the height of the flange, the thickness of the flange and the amount of hollow wear can be measured with this one gage. The gage is very simply constructed and easily and quickly read after the measurements have been taken.

Fig. 8 shows a special tram used in Roanoke shops for tramming locomotive parts and those of machines and other equipment being built and repaired. The tram is equipped with a special device to which is attached a dial indicator, which registers the error in thousandths of an inch. This arrangement insures a greater degree of accuracy than the ordinary "fixed point" trams in common use.

A set of special gages has been designed to test the accuracy of screws and nuts during the process of manufacture. These gages are used to insure the interchange-

ability of the parts after they have been shipped to the various storehouses for use in replacing parts that have been worn to the limit prescribed for certain parts of equipment used in connection with the maintenance of locomotives.

Gage for Keyways

Fig. 6 shows a special gage used at the Roanoke shops for laying off the eccentric-crank keyways in main crank pins. These keyways are milled in the main crank pins with a portable milling machine. *A* is the body of the gage, *B* is the screw used for tightening the gage on the main crank pin and the jaws of the gage are operated by the use of a scroll which is located on the back side of the gage. *C* is the face of the gage. *D* is the end of the main crank pin in which the keyway for holding the eccentric-crank arm in position on the main crank pin is milled. *E* is the adjustable steel center used for setting the gage in the correct position to provide the proper "throw" of the eccentric crank. The face of the arm of this gage is graduated for the various classes of locomotives which insures the correct location of the eccentric crank arm after the keyways have been milled in the crank pin. The gage described above is set by a standard eccentric-crank-arm gage which is placed in the center of the driving-wheel axle with a base that rests on the end of the axle. Fig. 6 shows both gages being used. These gages make it possible to obtain the greatest degree of accuracy in locating the eccentric-crank arms in the correct position in relation to the center of the driving-wheel axle and the outer end of the main crank pin.

The gages and measuring instruments and other equipment described in this article are just a few of the many used in various departments of Roanoke shops and make it possible to obtain the greatest possible degree of accuracy in the 30,000 different orders of material that pass through the shops annually. They are also used in the manufacture of the 45,000 items that find their way into the division storehouses.

New Type of Radiation For Air Compressors

The problem of cooling compressed air between the air compressors and the main reservoirs on modern locomotives is becoming more difficult as space for the conventional pipe coils becomes more restricted. Moreover, there is considerable difference of opinion regarding the amount of radiation actually required. For example, one modern 4-8-4 type locomotive is equipped with 120 ft. of $1\frac{1}{2}$-in. radiation pipe, whereas the same class of locomotive operating in the same climate and under approximately the same service conditions on another road, has only 20 ft. of $1\frac{1}{2}$-in. radiation pipe because of lack of space to accommodate more.

To meet the need for more compact radiation between locomotive air compressors and the main reservoir and also to provide variable capacity for summer and winter operation, the Wilson Engineering Corporation, 122 So. Michigan avenue, Chicago, has developed a new grid-type radiation unit or section, installed as shown diagrammatically in the drawing. The cores of these sections are alloy cast iron, factory tested hydrostatically to 250 lb. per sq. in. The fins are of aluminum, cast by a secondary process on the iron core. Calculations as to equivalent effectiveness of the grid section and conventional piping have been checked by carefully conducted standing tests and indicate that one standard grid section, $34\frac{1}{8}$ in. long, furnishes the equivalent in radiating affect of 25 ft. of $1\frac{1}{4}$-in. pipe, or $22\frac{1}{2}$ ft. of $1\frac{1}{2}$-in. pipe, thus making it possible to install a much greater amount of radiation surface within any given space. The weight of each grid section is 75 lb.

To meet the requirement of variability, one or more sections is arranged in parallel to be cut in or cut, as necessary to avoid freezing. The first, or series, line of radiation is direct without obstruction, and with complete drainage from the compressor to the reservoir, thus

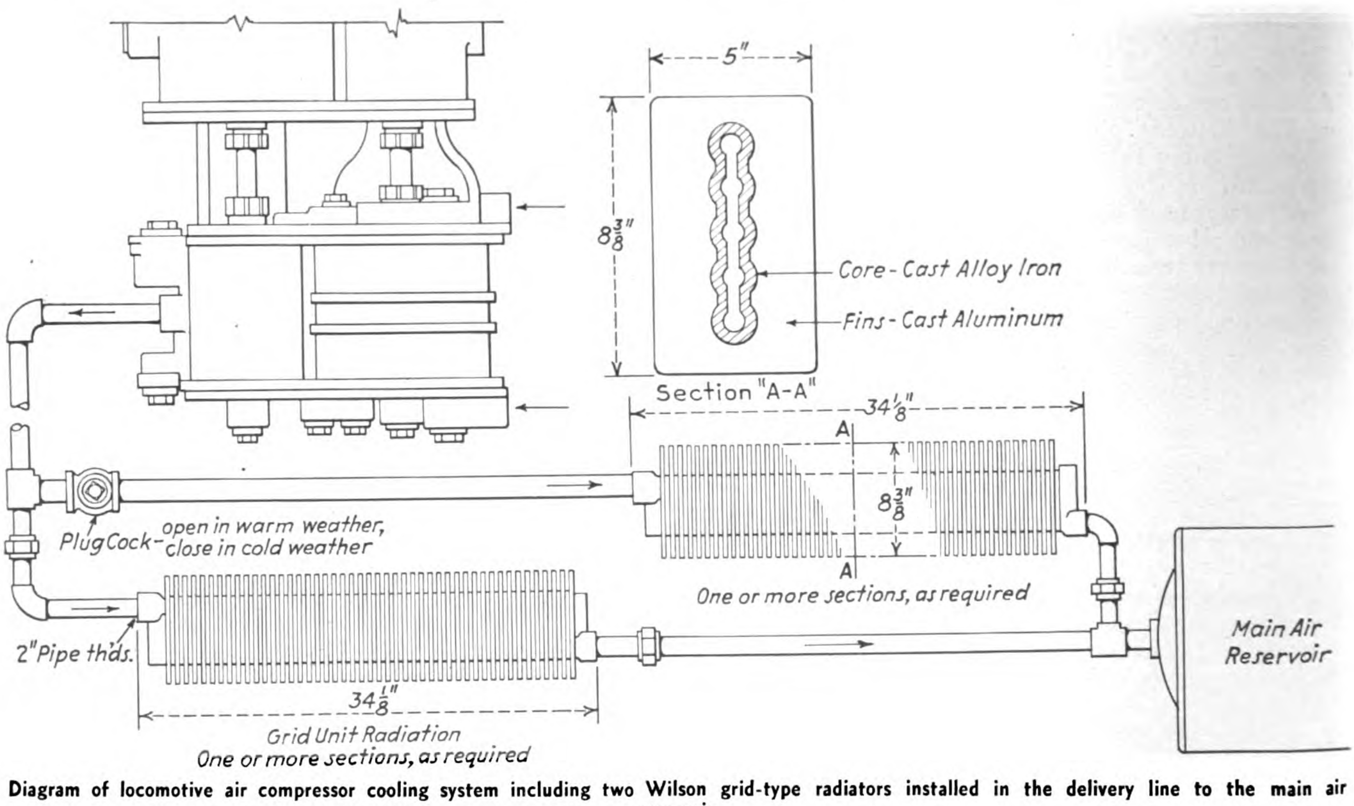


Diagram of locomotive air compressor cooling system including two Wilson grid-type radiators installed in the delivery line to the main air reservoir

assuring the absence of any hazard which might be occasioned by wrong setting of the valves, or by freezing. The parallel installation when required, is cut in by opening a shut-off cock and doubles the capacity.

The cost of the grid section compares favorably with the cost of equivalent standard piping when mounted with fittings, brackets and with consideration for labor. Substitution of grid sections for piping is recommended at times when locomotives are stripped in accordance with I. C. C. requirements, as there is then no extra labor cost. In case the piping which is removed is in good condition and can be used elsewhere, it may also be said that the application of the grid sections for compressor radiation does not entail additional investment cost.

The Wilson grid-type radiator units, designed to give compact air compressor radiation which may be easily varied in amount as desired, are said to be now in successful operation on locomotives of four railroads.

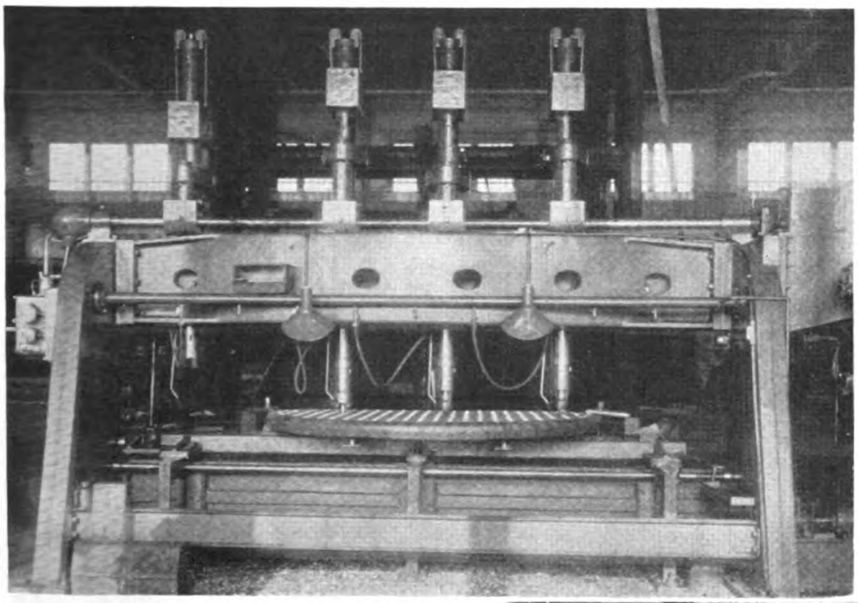
Multiple-Spindle Flue Sheet Drill

The modern four-spindle heavy-duty drilling machine, illustrated, was built by the Niles Tool Works, Hamilton, Ohio, and installed in the Union Pacific locomotive boiler shops at Omaha, Neb., a little less than a year ago. On account of its flexibility and ease of operation, the machine is adapted to a wide variety of heavy drilling operations normally encountered in boiler maintenance work, but the one job on which it has shown distinct economies is the drilling of boiler flue sheets.

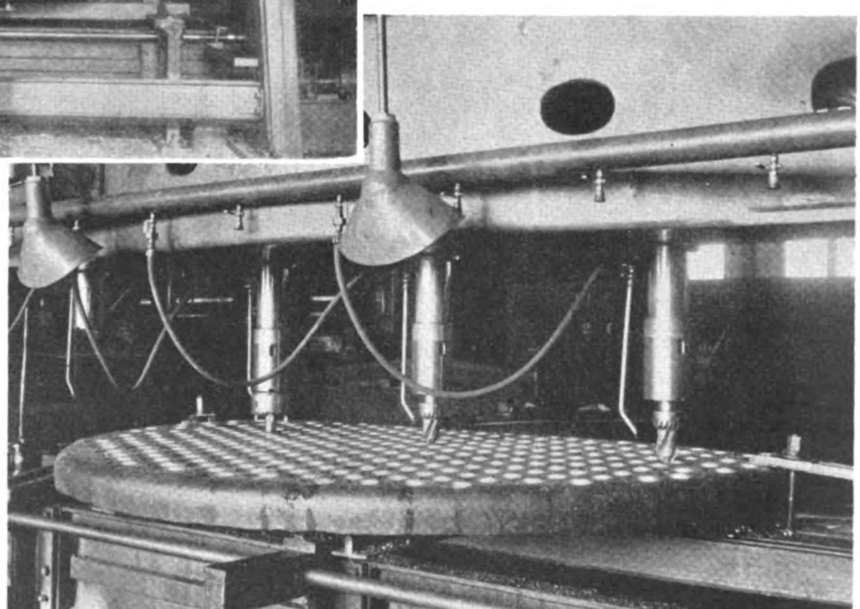
The machine is provided with push button control. Spindle speeds range from 20 to 210 r.p.m., available in 12 steps. Four feeds are available; namely, .017 in., .0125 in., .009 in., and .0065 in. per revolution.

In the drilling of flue sheet holes, which is really a production job, the holes are laid out and $1\frac{11}{16}$-in. pilot holes punched. The flue sheet is then clamped on the drilling machine table where two or three spindles may be used simultaneously as needed in cutting the holes to the proper size. In finishing the holes for $2\frac{1}{4}$-in. tubes, the combination drill and counterbore, shown in the two spindles at the right in the close-up view, is used, this tool enlarging the hole to the proper size and slightly chamfering the edge of the hole to remove the burr and leave a smooth corner which will not cut the tube bead when it is formed. A larger combination drill and counterbore is used to cut suitable holes for the swedged ends of the $3\frac{1}{2}$-in. Type-E superheater flues.

For the $5\frac{1}{2}$-in. Type-A superheater flues, the Pratt & Whitney trepanning tool, shown in the third spindle, is used. This tool is equipped with four cutters, adjustable as to position and relieved so as to cut a smooth hole $4\frac{9}{16}$ in. in diameter. The outer diameter of the tool



Left:—A modern Niles four-spindle heavy-duty drilling machine, recently installed in the Union Pacific locomotive boiler shop at Omaha, Neb.—The machine is notable for its high productive capacity and ease of operation

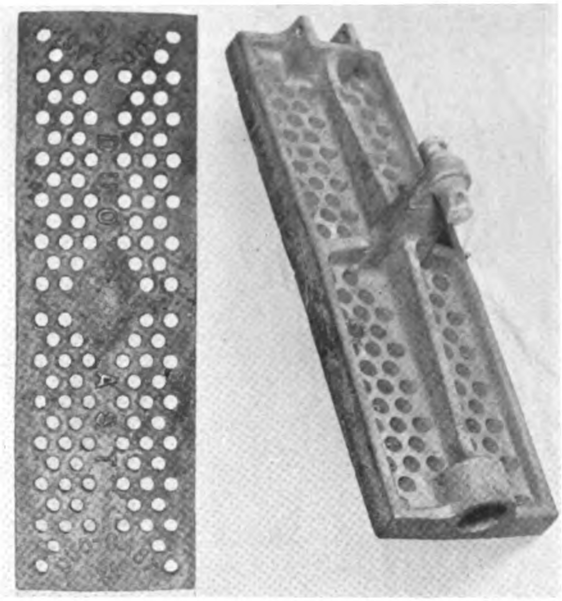


Right:—The Niles machine drilling a back flue sheet—Two spindles are shown equipped with combination drill and counterbore tools and one with a P. & W. trepanning tool, also designed to counterbore

is $5\frac{1}{2}$ in. and it is equipped with a 45-deg. counterbore, as illustrated, to remove all burrs and rough edges at each hole. Approximately 2 hr. 45 min. are required to cut forty-five $4\frac{9}{16}$-in. holes in a flue sheet with this tool. The flue sheet, shown in the illustration, has three $2\frac{5}{16}$-in. holes and 259 $3\frac{3}{16}$-in. holes which require approximately $6\frac{1}{2}$ hr. for drilling, including counterboring the holes on the reverse side with a portable air-operated tool, handled by two men.

Duo-Cast Locomotive Grates Tested

It is commonly recognized that cast iron is the best metal for heat resistance in locomotive grates, but that the strength of steel is desirable for maximum shock resistance and freedom from breakage. With this thought in mind, the Standard Brake Shoe & Foundry Company, Pine Bluff, Ark., has perfected a method of casting locomotive grates with an iron upper surface and a steel base which perform satisfactorily the double function of resisting heat in that portion of the grates subjected to the highest temperatures and giving exceptional strength in the supporting base structure. Test sets of locomotive grates, made of Duo-Cast metal, as it is called, have been in service since 1935, and, while representing a somewhat higher first cost, are said to give at least four times the service life of grates of like design made of ordinary gray iron.

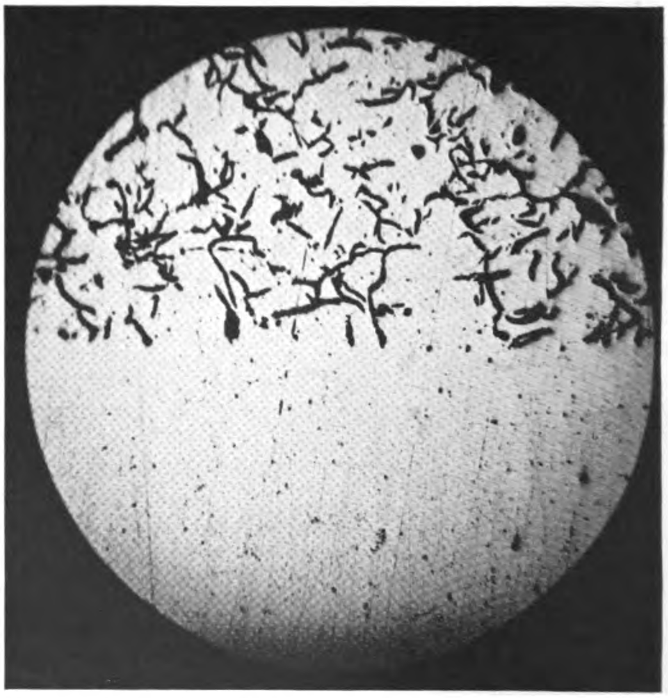


Unretouched photographs of Duo-Cast locomotive grate removed for inspection after giving more than four times the usual grate life

One important advantage which the manufacturer claims for the use of Duo-Cast metal in locomotive grates is that no particular type or design of grate is recommended, and Duo-Cast grates can be made from present patterns, with no change in a railroad's standard grate arrangement and design. The grate mold is simply poured with molten steel in the lower part to give strength where it is needed and then, after a specified time, the iron portion is poured, filling the mold into the risers. The iron used is a special heat-resisting metal known as Stanfire iron. The iron and steel are poured in such a way as to provide a practically perfect fusion of the two metals, as indicated in the illustrations, thus making a grate in which the bottom portion of the grate body and all of the underframe are made of strong cast steel, and the upper portion of Stanfire iron to protect the steel from the heat of the fire-bed.

Polished section of Duo-Cast grate showing effective union between the upper iron and the lower steel portions

The successful combination of these two materials in a single casting necessitated a long period of laboratory research and experimentation, using various metal combinations and different pouring methods, before the proper fusion was effected. The principal difficulty was to secure a union of the iron and steel sufficiently strong to hold in spite of differences in coefficient of expansion



Microphotograph of unetched section of Duo-Cast grate, magnified 90 diameters, indicates the practically perfect fusion of the two metals

of the two metals, and after this problem had apparently been solved in the laboratory and foundry, it was necessary to prove by service tests that the fusion of the two metals was such that they would not separate in actual service.

One factor which helped was the fact that differences of temperature in the firebox and in the ash pan are roughly in the same proportion as differences in the coefficient of expansion of iron and steel. At any rate, service tests of Duo-Cast locomotive grates, made over a period of years, seem to prove that the two metals are effectively and permanently fused and that grates made of this material are adapted to give long service life, free from sagging, warping, or growth, which would be expected with all-steel grates, and without the burning and breakage commonly experienced with grates made of ordinary gray iron.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

The Efficiency of A Boiler Patch

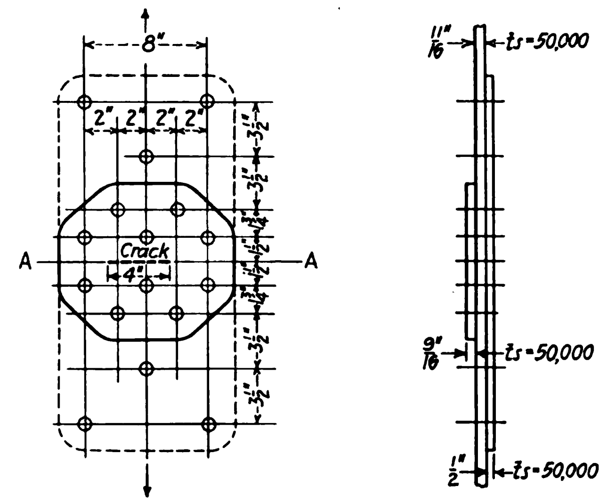
Q.—Considering the ultimate strength, a piece of 11/16-in. plate 8 in. wide will withstand a pull of 275,000 lb. The efficiency of a butt joint as shown in the illustration appears to be 86.6 per cent, then the joint will withstand a pull of 238,000 lb. If the straps should cover a 4 in. crack the pull on the patch would be 137,500 lb.; and the efficiency of the patch would appear to be 173 per cent. May any resistance be attributed to metal in the 11/16 in. sheet along section A-A in the case of the cracked sheet?—W. H. B.

A.—The patch submitted with the question and shown in the illustration could fail in the following manner:

(1) Tearing of the plate through rivet holes in the outer row.

(2) Tearing of the plate between the rivet holes in the third row and shearing two rivets in single shear in the first and second rows.

(3) Shearing four rivets in double shear in the third and fourth rows and two rivets in single shear in the first and second rows; also, tearing the shell plate from



1 1/16" Holes, 1" Steel Rivets, Ss-44,000 Lb. sq. in.

What is the efficiency of this patch?

the ends of the crack out to the sides of the patch.

(4) Tearing of the plate between the rivet holes in the third row and fourth rows and the welt strip in front of the two rivets in the first and second rows.

(5) Crushing of the shell plate in front of four rivets in the third and fourth rows and the welt strip in front of two rivets in the first and second rows; also, tearing the shell plate from the ends of the crack out to the sides of the patch.

The efficiency of the patch is computed by using the equations in the accompanying table; the numbers of the equations correspond to the numbers of the foregoing paragraphs. The notations used in these equations are as follows.

TS = tensile strength of plate = 50,000 lb. per sq. in.; t = thickness of shell plate = 11/16 in.; B = thickness of welt strips = 9/16 in.; P = pitch of rivets, on the row having the greatest pitch = 8 in.; D = diameter of rivet after driving = diameter rivet hole = 1 1/16 in.; A = cross-sectional area of rivet after driving, = 0.8866 sq. in.; s = shearing strength of rivet in single shear = 44,000 lb. per sq. in.; S = shearing strength of rivet in

Efficiency of the Patch for Different Methods of Failure

(1) $$\frac{(P-D)\times TS\times t}{P\times TS\times t}=\frac{(8-1.0625)\times 50000\times 0.6875}{8\times 50000\times 0.6875}=0.867 \text{ or } 86.7 \text{ per cent.}$$

(2) $$\frac{[(P-2D)\times TS\times t]+(2A\times s)}{P\times TS\times t}=\frac{[8-(2\times 1.0625)\times 50000\times 0.6875]+(2\times 0.8866\times 44000)}{8\times 50000\times 0.6875}=1.018=101.8 \text{ per cent.}$$

(3) $$\frac{(4A\times S)+(2A\times s)+[(P-E)\times TS\times t]}{P\times TS\times t}=\frac{(4\times 0.8866\times 88000)+(2\times 0.8866\times 44000)+[(8-4)\times 50000\times 0.6875]}{8\times 50000\times 0.6875}=1.918 \text{ or } 191.8 \text{ per cent.}$$

(4) $$\frac{[(P-2D)\times TS\times t]+(2D\times C\times B)}{P\times TS\times t}=\frac{[\{8-(2\times 1.0625)\}\times 50000\times 0.6875]+(2\times 1.0625\times 95000\times 0.5625)}{8\times 50000\times 0.6875}=1.147 \text{ or } 114 \text{ per cent.}$$

(5) $$\frac{(4D\times C\times t)+(2D\times C\times B)+[(P-E\times TS\times t]}{P\times TS\times t}=\frac{(4\times 1.0625\times 95000\times 0.6875)+[(2\times 1.0625)\times 95000\times 0.5625]+[(8-4)\times 50000\times 0.6875]}{8\times 50000\times 0.6875}=1.922 \text{ or } 192.2 \text{ per cent}$$

(6) $$\frac{(4D\times C\times t)+(2A\times s)+[(P-E)\times TS\times t]}{P\times TS\times t}=\frac{(4\times 1.0625\times 95000\times 0.6875)+(2\times 0.8866\times 44000)+[(8-4)\times 50000\times 0.6875]}{8\times 50000\times 0.6875}=1.793 \text{ or } 179.3 \text{ per cent.}$$

double shear; C = crushing strength of plate = 95,000 lb. per sq. in. and E = length of crack = 4 in.

The efficiency of the patch would be the least value obtained from Equations 1, 2, 3, 4, 5 or 6 in the table which would be 86.7 per cent as found in Equation 1. The efficiency of this patch, therefore, is determined by the strength of the plate between the rivet holes of the outside pitch.

The fact that the patch covers a crack 4 in. long does not allow one to assume that the pull on the plate is only for the length of the cracked portion. The pull on the plate between the outer row of rivets will be 275,000 lb. irrespective of the length of the crack; therefore, the efficiency through the outside row of rivets or 86.7 per cent, will be the efficiency of the patch whether the length of the crack is 4 in. or 8 in. In determining the efficiency of the patch, Equations 3, 5 and 6 in the table are affected by the length of the crack.

Open and Sealed Arches Are Defined

Q.—What is meant by a sealed and an open arch? Which is considered the best type of arch construction?—A. P.

A.—A sealed arch is one where the firebrick is set down next to the firebox throat sheet, the brick being tight against the sheet or sealed with fire-clay.

An open arch is one where the firebrick adjacent to the firebox throat sheet is set back away from the sheet by means of spacer bricks, leaving an opening between the sheet and the first row of firebricks.

The use of the sealed or open arch depends upon the construction of the arch, the use of syphons, and the kind of coal burned. It can only be determined by trial which type of arch construction is the best for a given boiler, and for different kinds of coal used in the same boiler.

With a sealed arch there is a tendency for cinders and slag to form in the pocket formed by the arch and the tube sheet; the cinders and slag plug up the lower tubes. To overcome this condition, the open arch is installed, allowing the cinders to fall down onto the grates.

In applying spacer bricks, care should be taken to keep the top of the arch down, so as not to restrict the gas area between the back end of the arch and the crown sheet, or the gas area between the back end of the arch and the firedoor sheet, to less than 115 per cent of the total flue and tube area.

Maximum Allowable Working Pressure on Water Tubes

Q.—If in a water-tube boiler the tubes enter a 42-in. drum at a butt seam, the thickness of the plate is 5/8 in., the thickness of the straps is 9/16 in., and the ligament efficiency is 36.6 per cent, what is the maximum allowable working pressure?

A.—The maximum allowable working pressure on the shell of a boiler or drum for temperatures not to exceed 700 deg. F. shall be determined by (1) the strength of the weakest course, computed from the thickness of the plate with the tensile strength stamped thereon as provided for in the specifications for the material, (2) the efficiency of the longitudinal joint or of the ligament between the tube holes in the shell or drum (whichever is the least), (3) the inside diameter of the course, and (4) the factor of safety.

The maximum allowable working pressure can be determined from the formula

$$P_m = (TS \times t \times E) \; / \; (FS \times R)$$

where P_m = maximum allowable working pressure, lb. per sq. in.; TS = ultimate strength of the plate, lb. per sq. in.; t = minimum thickness of the shell plates in the weakest course, in.; E (the efficiency of the longitudinal joint or of ligaments between openings) for riveted joints = calculated riveted efficiency; E for fusion-welded joints = efficiency specified in Paragraph P-102 of the A. S. M. E. Boiler Code for seamless shells = 100 per cent; E for ligaments between openings = efficiency calculated by rules in Paragraphs P-192 and P-193 of the A. S. M. E. Boiler Code; FS = factor of safety = 5 for new construction; and R = inside radius of the weakest course of the shell or drum, in., provided the thickness of the shell does not exceed 10 per cent of the radius, or = the outer radius of this course when the thickness is over 10 per cent of the radius. The factor of safety used in determining the maximum allowable working pressure, calculated on conditions actually obtained in service, shall not be less than 5.

Substituting the values given in the question, and assuming TS = 55,000 lb. per sq. in. and FS = 5, we obtain the maximum allowable working pressure as $(55{,}000 \times 0.625 \times 0.366) \; / \; (5 \times 21)$ = 12,381.25.105 = 119.8 lb. per sq. in.

The Cracking of Outside Throat Sheets

Q.—We have considerable trouble with outside throat sheets cracking. The cracks extend vertically in the radius joining the throat sheet and the shell course. Can this trouble be overcome? Also, what is the proper way to repair a crack of this type?—R. E. L.

A.—The cracking of the throat sheet as stated in the question is no doubt due to stresses set up in the metal at this point due to the expansion and contraction of the boiler.

When the boiler is heated from a cold condition to full boiler pressure, there is a movement in the throat sheet, the plate tending to straighten out horizontally, and when the boiler becomes cold again, the sheet returns to its original position. The action of the water in the boiler also causes the temperature of the plates to vary, which results in a movement of the throat sheet. The more rapid the temperature changes, the quicker the fracture develops in the sheet.

The cracks also occur due to internal stresses set up in the plates at the time of flanging; there is considerable thinning of the plate at the time of flanging because of the extreme amount of flanging required in the throat sheet.

The design of the throat sheet itself might be the cause, in that, the radii of the corners are not sufficient to allow the necessary freedom in the plate for expansion and contraction.

A rigid connection between the throat sheet and the engine frame would also set up stresses in the throat sheet, due to the fact that the engine frame is rigid and the boiler expands and contracts.

This trouble can be corrected to some degree by installing sliding shoes where the boiler rests on the frame at the throat sheet; also, by lagging and jacketing the throat sheet, and by providing ample radii at the throat-sheet corners when making new throat-sheet applications.

To repair a throat-sheet crack, the crack should be veed out and welded, and a riveted patch, the same thickness as the throat sheet, applied over it. The patch should extend from the shell-course seam out to the firebox wrapper-sheet seam.

A comprehensive discussion of this subject appears in the 1938 proceedings of the Master Boiler Makers' Association.

High Spots in

Railway Affairs . . .

Wanted—A Name

Where does the Pullman Company get the names for its cars? Wherever it is, the source of supply seems to be running low and so that company is now offering prizes for the best name to be given the new Pullman "roomette" sleeping car which is being exhibited at the New York World's Fair. Entry blanks are to be distributed by ticket and Pullman agents. The prizes will include two free round-trips by Pullman to either the San Francisco or New York fair to those originating the 25 best names submitted, and 500 new one dollar bills for the "runners up."

Senate Transportation Hearings

When the Senate finally got around to considering transportation legislation it went at it with a will. Hearings on the Wheeler-Truman S. 2009, known as the "key bill" for Senate transportation legislation, began on April 3 and closed on April 14. Senator Wheeler insisted that no time be wasted and that the testimony be brief and to the point. With the hearing on that bill out of the way, hearings have been scheduled for the other Wheeler-Truman bills, including S. 1869 to amend the provisions of the law relating to railroad reorganizations; S. 1310, which will give the Interstate Commerce Commission regulatory authority over the so-called outside investments of the railroads; and S. 2016, the holding company bill. It is proposed to make these hearings broad enough to cover other bills which deal in one way or another with matters covered in the Committee-of-Six recommendations. These hearings will be cleared up expeditiously if Senator Wheeler maintains the pace that he has started.

Defends High Passenger Fares

The eastern railroads in July, 1938, were given permission by the Interstate Commerce Commission to increase their basic passenger fares 25 per cent, from 2 to 2½ cents per mile. A report recently issued shows that in the first six months of operation under the increased fare, there was a smaller decrease in revenues on the eastern railroads than in the southern and western groups, which operated under lower fares, chiefly 1.5 cents and 2 cents. The decline in passenger revenues for the six months ended February 1, 1939, for the eastern region averaged 8 per cent, as against the same six months in 1937 and 1938; for the western group the decline was 9.4 per cent, and for the southern group 15.6 per cent. The report says that while the experience gained since July has not been of long enough duration to be conclusive, the results thus far may well be regarded as significant.

Amlie Withdraws

Thomas R. Amlie, who was nominated by President Roosevelt to succeed Interstate Commerce Commissioner Balthasar H. Meyer, finally, after a long delay, requested the President to withdraw his name because of the intense opposition which developed in the Senate, making it impossible to secure confirmation of the nomination. Judging from his letter withdrawing the nomination, the President keenly resented the Senate's attitude. Mr. Amlie, who certainly owed the President some consideration for the courtesies extended to him by the Chief Executive, took a queer way of showing his appreciation. In a public statement which bristled with all sorts of sharp criticisms of his opponents, he passed the buck back to the President in these words: "The real explanation of the savage attack on me lies not in my own deeds or misdeeds, but in the political calculation that by branding me as a Communist and an anti-Christ, a real blow—a blow below the belt to be sure, but nonetheless a real blow—could be struck against you, Mr. President, and your administration."

One Railroad Bill Gets Under Way

The Chandler rail bill, HR-5407, which would give legal sanction to voluntary railroad reorganizations, has been passed by the House and sent to the Senate. The Senate has no companion bill and there is a question just how promptly the House bill will be given consideration. In the words of its author, "it is an effort to reduce to its simplest form a method for the reorganization of those railroads which have submitted their financial problems to their bondholders, stockholders and creditors, generally, and have obtained the approval of more than two-thirds of the aggregate amount of all claims affected by the proposed plan of reorganization." It is understood that Assistant Secretary of State A. A. Berle, Jr., is opposed to the bill. He has sent a letter to Senator Wheeler contending that it would permit the piling up of stale claims against a railroad, which would have to be paid or written off later, instead of resulting in a writing down of existing debts and interest charges.

Ten Minutes For Ten Cents

The transportation agencies in the New York metropolitan district are preparing for heavy traffic during the World's Fair. The Long Island Railroad expects exceptionally heavy traffic between the Pennsylvania Station in New York City and its special World's Fair Station, which was recently completed and will have a capacity for handling 20,000 people an hour in each direction. Trains made up of 12 multiple-unit electric cars will operate a non-stop shuttle service. These trains, each of which will accommodate about 900 persons, are scheduled for every few minutes in both directions during the hours the fair is open. Because of the nature of the traffic, no tickets will be issued, but automatic turnstiles will be provided at the station concourse for the flat 10-cent fare both for inbound and outbound passengers.

Transportation Legislation in the House

Hearings on the transportation bills in the House, extending over ten weeks, were completed on March 30. Immediately thereafter the Committee on Interstate and Foreign Commerce, in executive session, authorized the appointment of a subcommittee to take over the task and make recommendations. This sub-committee consists of the chairman of the committee, Clarence F. Lea of California, Representatives Crosser of Ohio, Bulwinkle of North Carolina, and Cole of Maryland, Democrats; also Wolverton of New Jersey, Holmes of Massachusetts, and Halleck of Indiana, Republicans. Naturally their recommendations will be awaited with keen interest. Chairman Lea is entitled to a lot of credit for the statesmanlike and thorough way in which his committee has functioned. It remains to be seen, whether out of all the great mass of conflicting material in their hands they can sort out the essentials and draft a bill or series of bills that will receive the approval of Congress and bring us nearer the solution of the transportation problem.

Among the Clubs and Associations

New England Railroad Club.—Annual banquet and entertainment May 9, Copley-Plaza Hotel, Boston, Mass.

Toronto Railway Club.—Meeting: April 24, Royal York Hotel, Toronto. A. A. R. sound slide films—"This Railroad Business," and "Friendliness Too."

Car Department Association of St. Louis.—Dinner 6:15 p. m., May 16, Hotel DeSoto, St. Louis, Mo.; meeting 8 p. m. Subject: Electric Welding as Applied to Railroad Equipment, with motion pictures. Speaker: E. W. P. Smith, consulting engineer, Lincoln Electric Company.

Car Foremen's Association of Omaha, Council Bluffs, and South Omaha Interchange.—Meeting: 1:30 p. m., May 11, Union Pacific, Council Bluffs, Iowa. Subject: Rules 68 to 75. Speaker: C. B. Stemple.

Indianapolis Car Inspection Association.—Meeting: May 1, Hotel Severin, Indianapolis, Ind. Subject: Locomotive Slipping Tests, with motion pictures and slides. Speaker: T. V. Buckwater, vice-president, Timken Roller Bearing Company.

Eastern Car Foremen's Association.—Meeting: April 14. Subject: Talking motion picture "The Story of the Chilled Car Wheel," with contributory paper on Wheel Defects and Failures by P. J. Hogan, supervisor car inspection and maintenance, New York, New Haven & Hartford.

Co-ordinated Mechanical Meetings.—Owing to a conflict in date with the American Legion convention, which will tax hotel accommodations to the limit in Chicago during the last week in September, arrangements have been made to hold the co-ordinated mechanical association meetings, without exhibits, at the Hotel Sherman during the third week in October. These associations include the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association, the International Railway General Foremen's Association and the Master Boiler Makers' Association.

Present plans call for a joint opening session to be addressed by an outstanding railway officer on Tuesday morning, October 17. The various associations will then adjourn to their respective meeting rooms for the consideration of individual papers and committee reports on the subjects in which each is especially interested. It is expected that an exhibition of railway equipment and supplies, sponsored by the Allied Railway Supply Association, will be held at the 1940 meeting of these associations.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

Air-Brake Association.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

Allied Railway Supply Association. — J. F. Gettrust, P. O. Box 5522, Chicago.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet avenue, Chicago.

American Society of Mechanical Engineers.—C. E. Davies, 29 West Thirty-ninth street, New York.

Railroad Division.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

Machine Shop Practice Division.—Erik Aberg, editor, Machinery, 148 Lafayette St., New York.

Materials Handling Division. — F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

Oil and Gas Power Division. — M. J. Reed, 2 West Forty-fifth street, New York.

Fuels Division.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

Association of American Railroads. — J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

Operating Section. — J. C. Caviston, 30 Vesey street, New York.

Mechanical Division.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Annual meeting June 28, 29 and 30, at the Commodore Hotel, New York.

Purchases and Stores Division.—W. J. Farrell, 30 Vesey street, New York. Convention of entire membership June 14-15, Palmer House, Chicago.

Motor Transport Division.—George M. Campbell, Transportation Building, Washington, D. C.

Canadian Railway Club. — C. R. Crook, 4468 Oxford avenue, Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal Que.

Car Department Association of St. Louis. — J. J. Sheehan 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, Hotel Mayfair, St. Louis, Mo.

Car Department Officers' Association.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago. Meeting third week in October, Hotel Sherman, Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel Chicago.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

Central Railway Club of Buffalo. — Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

Eastern Car Foreman's Association. — Roy MacLeod, Room 127, G. O. Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of each month, except May, June, July, August and September.

Indianapolis Car Inspection Association. — R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

International Railway Fuel Association. — See Railway Fuel and Traveling Engineers' Association. Meeting third week in October, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—F. T. James, general foreman D. L. & W., Kingsland, N. J.

International Railway Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

Master Boiler Makers' Association.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Meeting third week in October, Hotel Sherman, Chicago.

New England Railroad Club. — W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August, September, at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

Pacific Railway Club. — William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately, excepting June in Los Angeles and October in Sacramento.

Railway Club of Greenville.—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

Railway Fire Protection Association.—P. A. Bissell, 40 Broad street, Boston, Mass.

Railway Fuel and Traveling Engineers' Association.—T. Duff Smith, 1255 Old Colony building, Chicago. Meeting third week in October, Hotel Sherman, Chicago.

Railway Supply Manufacturers' Association.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

Toronto Railway Club.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

Traveling Engineers' Association.—See Railway Fuel and Traveling Engineers' Association.

Western Railway Club.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

(*Turn to next left-hand page*)

The unique exchange plan, possible only because a scrap wheel is the best basic raw material for a new wheel, has made, and will continue to make chilled car wheels more economical to buy, just as their unusual characteristics make them more economical to operate.

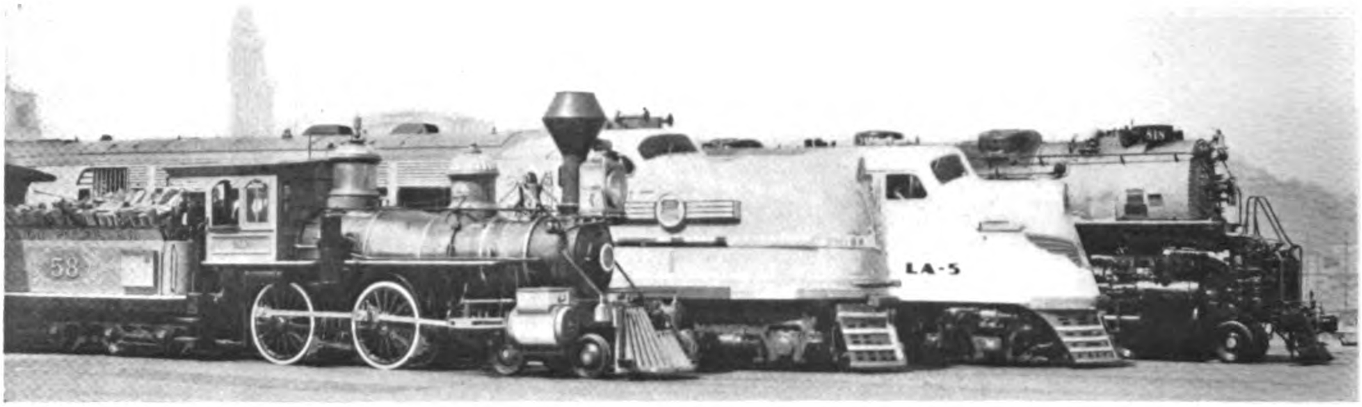
ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE,
NEW YORK, N. Y.

445 N. SACRAMENTO BLVD.,
CHICAGO, ILL.

AMCCW

ORGANIZED TO ACHIEVE:
Uniform Specifications
Uniform Inspection
Uniform Product



Old and new Union Pacific locomotives lined up at Los Angeles, Calif., preceding the world premier of the film "Union Pacific." Left to right: A wood-burning steam locomotive used in 1865; the new 5,000-hp. steam-electric locomotive built by the General Electric Company; the "City of Los Angeles" locomotive, built by the Electro-Motive Corporation, and a high-speed articulated steam freight locomotive built by the American Locomotive Company. The wood-burning and steam-electric locomotives are now on a transcontinental exhibition tour

NEWS

$45,000 for A. A. R. Research on High-Speed Freight Car Trucks

THE board of directors of the Association of American Railroads, at its March 31 meeting in Washington, D. C., voted a $45,000 appropriation for a one-year research project on high-speed freight car trucks.

J. J. Pelley, president of the Association of American Railroads, in a statement issued since that meeting, reveals that the project will take the form of "a series of tests to determine what improvements can be made in the construction of railroad freight-car trucks in order to better fit them to meet operating conditions resulting from greater high-speed freight service.

"These tests," Mr. Pelley continues, "will be the most comprehensive of their kind ever conducted by the railroads. Out of them are expected to result the development of a freight-car truck that can be used on freight trains moving at speeds as great as the fastest passenger trains now being operated in the United States. . . . Due to improvements in locomotives and freight cars and methods of operation, the average speed of freight trains in 1938 was 61 per cent higher than in 1920. In many instances freight trains are now being operated on what were formerly passenger-train schedules.

"The purposes of these tests will be to bring about: (1) Still greater improvement in safety on the railroads; (2) a continued improvement in service to the public by expediting still further the movement of freight; (3) reduced maintenance, both to equipment and road-bed; and (4) increased efficiency in operation."

Approximately one year is expected to be required to complete the tests and the preparation of a report. The road tests will be run over the Pennsylvania from Altoona, Pa., to Lock Haven, Pa., a round trip distance of 156 miles. They will be under the general direction of W. I. Cantley, mechanical engineer, Mechanical Division of the A. A. R. W. E. Gray, engineer of draft-gear tests of the Association, will be in direct charge of the tests.

Railroad freight-car truck manufacturers located in various parts of the United States have turned over to the A. A. R. about a dozen different types of freight-car trucks for testing purposes. Each one will be given a separate and thorough test under varying conditions, both as to load of cars and as to speed. Test runs between Altoona and Lock Haven will be made every other day, the intervening time between runs being devoted to installing the various freight-car trucks and to making changes in the load of the cars used in the test runs.

Machinery and Tools

THE Missouri Pacific will spend approximately $110,000 for machinery and tools with which to improve efficiency and reduce operating costs in its car and locomotive shops. Orders have been placed as follows: with the Hoffmann-Marquard Iron & Machinery Company, St. Louis, Mo., for a planer and matcher to be built by the Yates-American Machinery Company, Beloit, Wis., for use at its machine shop at DeSoto, Mo., and with the R. R. Stephens Machinery Company, St. Louis, for two 24-in. vertical boring mills, to be built by the Bullard Machine Tool Company, Bridgeport, Conn., for installation in the railroad's Ewing avenue shops at St. Louis, and the enginehouse machine shop at North Little Rock, Ark. A 30-in. engine lathe has been ordered from the Lehmann Machine Company, St. Louis, for installation in the railroad's machine and erecting shop at Kansas City. A punch and shear has been ordered from Williams, White & Company, Moline, Ill., for use in the railroad's shops at DeSoto. An order has been placed with the Blackman & Neutzel Machine Company, St. Louis for a machine to process locomotive bolts, which is being built by the Sunstrand Machine Company, Rockford, Ill., for installation in the shops at Sedalia.

Revised Specifications for Passenger Equipment

REVISED specifications for passenger equipment recommended by the General Committee of the Association of American Railroads, Mechanical Division, were approved by the A. A. R. board of directors at its Washington, D. C., meeting on March 31. The board also directed that the specifications thus approved be transmitted to member roads for adoption as recommended practice of the A. A. R.

The revised specifications were sent out to member roads on April 4 with a letter from A. A. R. President J. J. Pelley. The material accompanying Mr. Pelley's letter reveals that the revised specifications were prepared on a basis whereby they will produce passenger cars suitable for use with cars of all types of construction, now in service and built in accordance with Railway Mail Service Specifications, as revised July 30, 1938—with the result that new and existing cars will satisfactorily operate together with maximum protection under all conditions of service.

Reviewing developments leading to the adoption of the revised specifications, the Pelley letter to member roads recalls that on January 9, 1939, a Special Engineering Committee of the Mechanical Division was appointed to prepare, in co-operation with car builders and materials manufacturers, a set of minimum specifications to cover future construction of new passenger cars. Specifications were prepared and submitted to the A. A. R. board on February 24, whereupon the board directed the Mechanical Division to submit such specifications to member roads for comment and suggestions. On the basis of such comment

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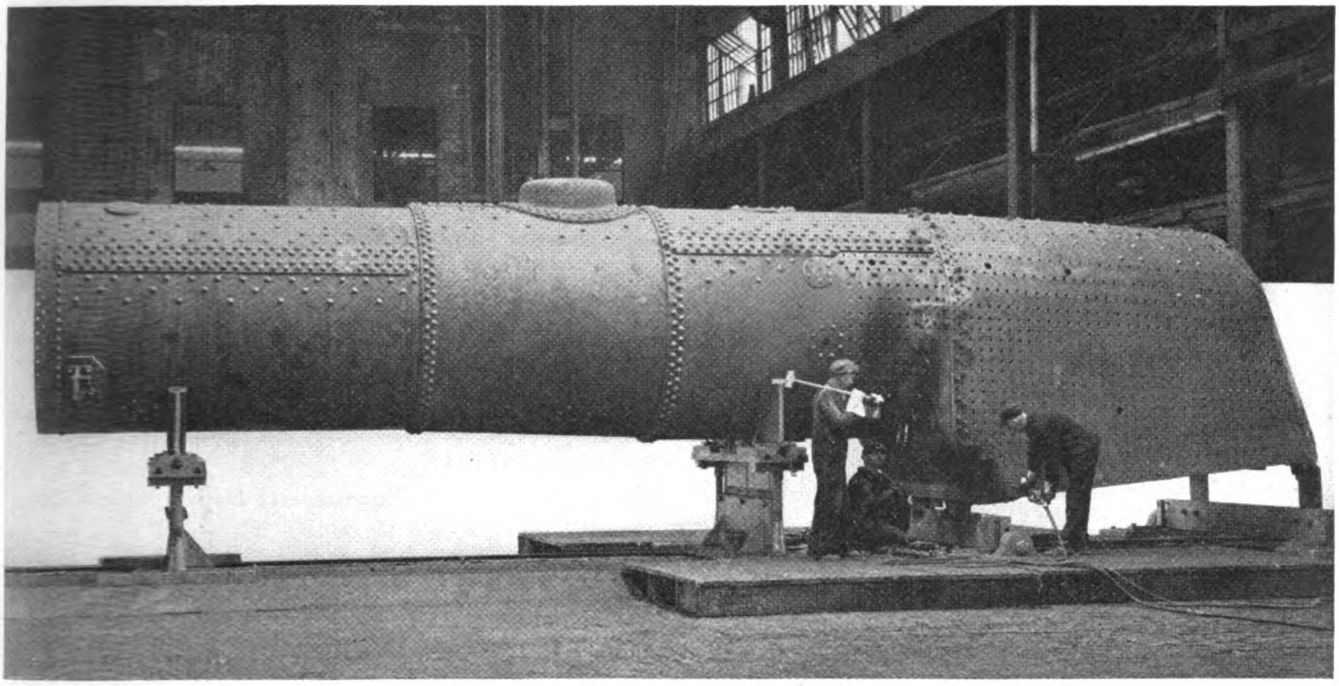
METHODS AND MACHINERY THAT GUARD LIMA QUALITY



PROPERLY ALIGNED BOILERS

. . . are essential to low maintenance

Perfect alignment between boiler shell and back end both horizontally and vertically are essential to a low-maintenance locomotive.

As boilers grew larger and longer this became more difficult of accomplishment.

At Lima the problem is solved by the boiler jig pictured above. By means of this, the boiler back end is accurately lined up with the shell of the boiler before the rivet holes are reamed. Perfect alignment is assured. It's by such methods that Lima has developed its reputation for building sound, low-maintenance power.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

and suggestions, the Mechanical Division's Special Engineering Committee prepared a revised set of specifications which was approved by the General Committee and recommended for adoption as recommended practice.

Proceedings Fuel and Traveling Engineers' Association

THE proceedings of the Railway Fuel and Traveling Engineers' Association cost $3, not $2 as mentioned in the review on page 107 of the March issue of the *Railway Mechanical Engineer.*

Air Conditioning—Correction

IN the table showing the Nine-Year Summary of Air-Conditioned Cars appearing on page 141 of the April issue, the total of 275 cars of the C. M. St. P. & P. appearing as ice-equipped should be shown as equipped with the steam-ejector system. This transfer changes the grand totals of ice-equipped cars from 4,055 to 3,780 and of the steam-ejector-equipped cars from 1,587 to 1,862.

Stoker Appeal Deferred

RAILROADS will defer their decision with respect to further court appeals from the Interstate Commerce Commission's order in the automatic stoker case until J. J. Pelley, president of the Association of American Railroads, has had an opportunity to discuss the matter with D. B. Robertson, president of the Brotherhood of Locomotive Firemen & Enginemen. This decision was reached at a meeting of the A. A. R. board of directors held at Washingon, D. C., on March 31.

As noted in the April issue of the *Railway Mechanical Engineer*, the Interstate Commerce Commission had postponed to April 15 the effective date of this order, which had recently been upheld by a three-judge federal court at Cleveland, Ohio.

Experimental Cars Authorized

THE Interstate Commerce Commission, in a decision by Commissioner McManamy, has authorized the General American Transportation Corporation to construct 30 additional fusion-welded tank cars for experimental service in the transportation of caustic soda solution.

The Commission, through Commissioner McManamy, has also authorized the Union Tank Car Company to construct 100 fusion-welded tank cars for experimental service in the transportation of petroleum products.

$583,282,000 for Supplies in 1938

PURCHASES of fuel, materials and supplies used by the Class I railroads in the United States in connection with their operation amounted to $583,282,000 in 1938, J. J. Pelley, president of the Association of American Railroads recently announced. These 1938 purchases were smaller than in any year since 1933 and were a reduction of $383,101,000 under those in 1937. The reduction under the preceding year, Mr. Pelley's statement says, "resulted primarily from the serious financial condition of the railroads, and from enforced reductions in maintenance work, as well as increased efficiency in operation which particularly affected fuel purchases."

In 1930 railway purchases for fuel, materials and supplies amounted to $1,038,500,000.

Class I railroads in 1938 expended $243,783,000 for fuel compared with $294,293,000 in 1937. For bituminous coal only, their purchases totaled $180,074,000, a decrease of $36,201,000 compared with the preceding year, while for anthracite, they totaled $3,333,000, a decrease of $575,000 compared with 1937. Purchases of fuel oil in 1938 amounted to $53,553,000 compared with $65,856,000 in the preceding year. For gasoline, there was an expenditure of $4,120,000 in the past year, while for all other fuels, including coke, wood, and fuel for illumination, expenditures amounted to $2,703,000.

Class I roads, in 1938, purchased iron and steel products amounting to $152,176,000 compared with $359,409,000 in 1937, or a decrease of $207,233,000. For locomotive and car castings, beams, couplers, frames and car roofs, the railroads spent $22,221,000 in 1938 compared with $62,373,000 in the preceding year.

For wheels, axles and tires, the railroads expended $16,691,000 compared with $31,173,000 in the preceding year, while for bar iron and steel, spring steel, tool steel, unfabricated rolled shapes, wire netting and chain, boiler, firebox, tank and sheet iron and steel of all kinds their expenditures amounted to $7,910,000 compared with $32,186,000 in the preceding year. Purchases of standard and special mechanical appliances for locomotives in 1938 totaled $6,447,000.

Miscellaneous purchases made by the Class I roads totaled $130,355,000 in 1938 compared with $207,974,000 in 1937. Under the heading were $14,237,000 for lubricating oils and grease, illuminating oils, boiler compound and waste; $3,696,000 for passenger car trimmings, and $5,792,000 for locomotive, train and station supplies.

Lackawanna's World's Fair Exhibit

THE equipment exhibit of the Delaware, Lackawanna & Western which recently arrived at the site of the New York World's Fair after exhibition at various points along the road's main line from Scranton, Pa., to Hoboken, N. J., consists of old locomotive No. 952, a "Mother Hubbard" type of the 4-4-0 wheel classification in service on the road between 1900 and 1937; a modern passenger locomotive bearing the number 1939; a present-day refrigerator car, and a special lading car for handling bulk cement. Locomotive No. 952 will be presented to the Railway & Locomotive Historical Society at the close of the Fair. Locomotive 1939 has been fitted with a side panel skirting the boiler, upon which is inscribed "Pocono Mountain Route," while the name of the railroad has been applied in gold leaf on the tender, together with striping in silver leaf.

Equipment Depreciation Rates

EQUIPMENT depreciation rates for seven railroads including the Boston & Maine have been prescribed by the Interstate Commerce Commission in a new series of sub-orders and modifications of previous sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies. The composite percentages which are not prescribed rates range from 2.91 for the B. & M. to 10.96 for the Southern New Jersey.

The sub-order relating to the B. & M. is a modification of a previous sub-order, and it prescribes rates as follows: Steam locomotives, 3.01 per cent; other locomotives, 3.1 per cent; freight-train cars, 2.91 per cent; passenger-train cars, 2.63 per cent; work equipment, 3.67 per cent; miscellaneous equipment, 14.07 per cent.

New Equipment Orders and Inquiries Announced Since the Closing of the April Issue

LOCOMOTIVE ORDERS

Company	No. of Locos.	Type of Loco.	Builder
Missouri Pacific	2	900-hp. Diesel-elec.	Electro-Motive Corp.
	2	600-hp. Diesel-elec.	Electro-Motive Corp.
	1	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	1	1,000-hp. Diesel-elec.	Baldwin Loco. Works
	1	1,000-hp. Diesel-elec.	American Loco. Co.
Phelps Dodge Corp.	4	1,000-hp. Diesel-elec.	Electro-Motive Corp.
Wabash Car & Equip. Co.	3[1]	600-hp. Diesel-elec.	Electro-Motive Corp.
	1[1]	600-hp. Diesel-elec.	American Loco. Co.

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Great Northern	1,000[2]	50-ton box	Pullman-Std. Car Mfg. Co.
Maine Central	300	40-ton box	Magor Car Corp.
Missouri Pacific	1,025[3]	Gondola	Mt. Vernon Car Mfg. Co.
	125[3]	Box	Mt. Vernon Car Mfg. Co.
United Carbon Co.	10	40-ton hopper	American Car & Fdry. Co.

FREIGHT-CAR INQUIRIES

Union Railroad Co.	10	Caboose	....
Union Tank Car Co.	10-30	4,600-gal. tank	....

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Missouri Pacific		See Footnote[3]	
Pullman Co.	2[4]	Sleepers	Pullman-Std. Car Mfg. Co.

[1] To be leased to the receivers of the Wabash Railway Co.

[2] Approximate cost $3,000,000.

[3] The box cars and 25 gondolas are for the Missouri Illinois. The order for the locomotives for the streamline trains has been placed with the Electro-Motive Corporation and the order for the cars with the American Car and Foundry Company. Each of the trains will consist of a 2,000-hp. locomotive, a mail-baggage car, a mail-storage-express car, two deluxe coaches, a diner-cocktail-lounge car and a parlor-observation car. They will be placed in service between St. Louis, Mo., and Omaha, Neb., on a schedule of 9-hr. The cost of the trains, the locomotives, and the freight cars is estimated at $5,000,000.

[4] For use in the City of Denver of the Union-Pacific-Chicago & North Western. Each car will contain four roomettes, four double bedrooms, three compartments and one drawing room.

(Turn to second left-hand page)

SECURITY CIRCULATOR

AFTER 5 YEARS OF TESTING ON 12 RAILROADS

A number of years ago the increasing size of fireboxes started the American Arch Company engineers looking for a more satisfactory method of supporting arches of unusual length.

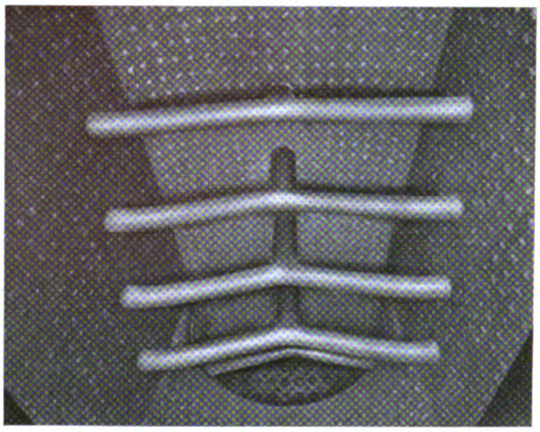
From this the Security Circulator has developed.

Now after 5 years of successful testing of over 100 Circulators in 22 locomotives, on 12 railroads, the American Arch Company announces Security Circulators for application to any type of steam locomotive.

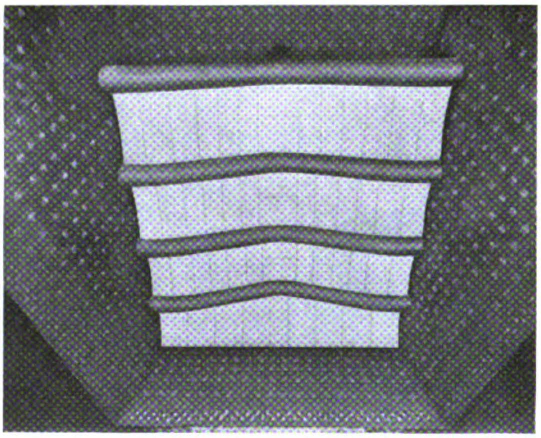
Test applications on every type of modern power under the worst water conditions have shown the Security Circulator to have the following advantages:

1. It supplies a better arch support; permitting the use of a 100% arch in any type of firebox.
2. It reduces honeycombing, flue plugging and cinder cutting.
3. It creates circulation in the side water legs.
4. It improves combustion.

Security Circulators have been so successful on test that we are now receiving many repeat orders.



View illustrating the positioning of Security Circulators in an average size of locomotive firebox prior to installing the brick arch.



Typical Security Circulator and brick Arch Installation in a locomotive firebox. The small sectional brick are as readily applied as in an ordinary arch tube firebox.

ARCH COMPANY, INC.

Security Circulator Division

Supply Trade Notes

HARRY GLAENZER, vice-president of The Baldwin Locomotive Works, has assumed new and enlarged responsibilities in connection with the engineering activities of the company. He will devote all his time to research and investigation in an effort to develop advances and improvements in the field of railway motive powers. Ralph P. Johnson has been appointed chief engineer, succeeding Mr. Glaenzer, and Charles F. Krauss and E. J. Harley, Jr., will as-

Harry Glaenzer

sist Mr. Johnson, each with the title of assistant chief engineer.

Mr. Glaenzer received his education in the technical schools of Baltimore, Md., and the University of Pennsylvania. He first became connected with the engineering department of The Baldwin Locomotive Works in March, 1899, and was appointed vice-president in charge of engineering on July 1, 1922.

◆

H. B. SPACKMAN, vice-president in charge of sales of Lyon Metal Products, Inc., Aurora, Ill., has been elected a di-

H. B. Spackman

rector. Mr. Spackman has been with the Lyon company for two years, coming to them from the U. S. Gypsum Company.

◆

PAUL A. CONDIT has joined the Cooper-Bessemer Corporation, Mt. Vernon, Ohio, in the capacity of control engineer.

CHARLES L. HEATER, assistant vice-president of the American Steel Foundries, Chicago, has been elected vice-president. Mr. Heater was born in Mandan, N. D., on August 5, 1894, and was graduated from Purdue University in 1917. Upon graduation, he entered the army air service and

Charles L. Heater

served overseas for eighteen months as captain of the 11th Aero Squadron. On November 1, 1919, at the end of the war, he entered the employ of the American Steel Foundries as a traveling apprentice, and after working in various plants throughout the country, was appointed sales agent at Chicago on January 1, 1925. He held this position until April 1, 1932, when he was promoted to general sales engineer. On November 1, 1937, he became assistant vice-president.

◆

HENRY JUDE has been appointed general sales manager of the Locomotive Equipment Division of Manning, Maxwell &

Henry Jude

Moore, Inc., Bridgeport, Conn., to succeed C. H. Butterfield, who was recently elected vice-president in charge of sales of the Industrial and Locomotive Divisions. Mr. Jude has been associated with the corporation for the past 33 years, having started in 1905 as an office boy. His various promotions have covered sales work in numerous capacities, also office management, and in 1934 he was appointed assistant general sales manager of the Locomotive Equipment Division. He is a Mechanical Engineer with a B.S. degree. During the emergency of the National Industrial Recovery Act in 1933 he was elected a member of the Code Authority in which capacity he represented Manning, Maxwell & Moore, Inc., in the Locomotive Appliance Institute.

◆

ERVIN J. SANNE, district sales manager of the Inland Steel Company, with headquarters at St. Paul, Minn., has been ap-

Ervin J. Sanne

pointed assistant manager of sales of the Sheet and Strip Steel division, with headquarters at Chicago, and has been succeeded by Frederick A. Ernst, assistant district sales manager at St. Louis, Mo. Harry A. Johnson of the St. Paul office has been appointed assistant district sales manager at St. Paul.

E. J. Sanne has been district sales manager of the Inland Steel Company at St. Paul since 1936. Prior to that time he

Frederick A. Ernst

was associated with Joseph T. Ryerson & Son, Inc., now a subsidiary of the Inland Steel Company, having entered the employ of that company in 1917. He was in the sales department at Chicago from 1921 to 1936.

(Continued on next left-hand page)

THE SUPERHEATER AS A FACTOR IN LOCOMOTIVE DESIGN

Reduced Fuel and Water Consumption Per Unit of Work Done

Locomotives equipped with Type "E" superheaters have shown this advantage to a high degree, as compared with other types and designs.

On a test plant in the United States, a locomotive underwent two comparative tests, first equipped with a Type "A" superheater and second with a Type "E" superheater. Except for the difference in superheaters, the locomotive was identical in each instance. The economies resulting from this test, which are disclosed in the accompanying table, are typical of the results that are being obtained in daily service.

COAL CONSUMPTION PER IHP

Output IHP	Type "A" Superheater	Type "E" Superheater	Reduction in Pounds	Saving in Per Cent
2000	2.85	2.25	0.6	21.0
3000	3.50	2.75	0.75	21.5
3500	4.25	3.25	1.0	23.5

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F. A. Ernst has been assistant district sales manager of the Inland Steel Company at St. Louis, Mo., since 1936. He entered the steel industry in 1914 with the Trumbull Steel Company and was successively affiliated with the Falcon Steel Company, the Granite City Steel Company and the Columbia Steel Company, prior to his association with the Inland Steel Company at St. Louis in 1928.

◆

THOMAS O'LEARY, JR., sales manager of the Western division of the Transportation Department of the Johns-Manville Sales

Thomas O'Leary, Jr.

Corporation, has been advanced to the position of sales manager of the Western Region of the Transportation Department, having jurisdiction over the Western, Southwestern and Pacific divisions of that department. His headquarters will be in Chicago, as heretofore. C. M. Patten has been appointed sales manager of the Southwestern division of the Transporta-

C. M. Patten

tion Department at St. Louis, Mo., succeeding A. C. Pickett, who has resigned.

Mr. O'Leary was born at San Francisco, Calif., and received his early training on the Southern Pacific. In 1911 he became associated with the New York Air Brake Company as mechanical representative in San Francisco, and later was sales representative at Denver, Colo. He then served, successively, as a second lieutenant and as a captain in the army, on his return after 15 months' service overseas, again becoming associated with the New York Air Brake Company. In 1925 he joined the sales force of Johns-Manville as a special representative, with headquarters at Salt Lake City, Utah. He was appointed assistant manager of the Western division of the Transportation Department in December, 1927, and sales manager of the Western division in February, 1935.

Mr. Patten was born in Delavan, Ill. He was in the employ of the Missouri Pacific from 1909 until 1917, when he entered the service of Johns-Manville as sales representative, with headquarters at St. Louis and later at Omaha, Neb. He returned to St. Louis in October, 1936, as assistant sales manager of the Southwestern division.

◆

JOHN E. DIXON, vice-president of sales and engineering of the Lima Locomotive Works, Incorporated, has been elected president, with headquarters at New York. Mr. Dixon was born on September 11, 1877, at Milwaukee, Wis. After attending grade and high schools, he studied at the University of Wisconsin, from which he was graduated with the degree of B. S. in mechanical engineering in 1900. He then served his apprenticeship at the Brooks Works of the American Locomotive Com-

John E. Dixon

pany, Dunkirk, N. Y., and was later, successively, shop foreman, traveling engineer, draftsman, and general inspector. From 1905 to 1907 he was assistant to manager and manager of the Atlantic Equipment Company, and from 1907 to 1916, salesman and assistant manager of sales of the American Locomotive Company. He left the American Locomotive Company on January 1, 1916, to become vice-president of sales of the reorganized Lima Locomotive Works. In 1934 Mr. Dixon assumed also the duties of vice-president of engineering. In 1936 his responsibilities were again broadened when he took over the direction of the Shovel and Crane Division of the Lima Locomotive Works, Incorporated.

◆

WALLACE G. SMITH has been appointed sales representative of The Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa. Mr. Smith was formerly with The Baldwin Locomotive Works and The Cramp Brass & Iron Foundries Co.

◆

FRANK W. DOYLE, member of the Waukesha Motor Company, Waukesha, Wis., sales staff for the past three years, has been appointed to the West Coast branch to represent both the engine and refrigeration divisions of the company.

◆

HERBERT K. WILLIAMS, assistant to the president and secretary of the Safety Car Heating & Lighting Co., New York, has been elected vice-president and J. H. Michaeli, assistant secretary and assistant treasurer has been elected secretary and assistant

Herbert K. Williams

treasurer. Mr. Williams was born at Orange, N. J., in 1888. He was graduated from Orange High School in 1905, and immediately entered the employ of the Safety Car Heating & Lighting Co., as a clerk in the office of the mechanical engineer. After six years of service in the engineering and executive departments of the company, and at the time the axle-lighting system for railway passenger equipment cars was just coming into prominence, Mr. Williams was transferred to the factory and spent a large part of his time in the laboratory in a general study of the theory and design of axle lighting and equipment. In 1916 he was assigned to the New York sales district as representative. Two years later the export business of the company was consolidated in the department over which Mr. Williams was placed in charge, although at the same time he continued his connection with the New York sales district. He was appointed sales engineer in 1926 and in 1928 was appointed manager of the equipment department in charge of sales. In April, 1933, he was appointed assistant to the president and since June, 1936, Mr. Williams served also as secretary of the company.

◆

F. C. MEYER has been assigned to the Chicago office of the Armstrong Cork Company, Lancaster, Pa. Mr. Meyer will be in charge of transportation sales in that territory for the company's industrial division.

◆

ROBERT C. STANLEY has been elected a director of the United States Steel Corporation and a member of the finance committee succeeding Walter S. Gifford. W. A. Irvin, after 44 years of service with the corporation, has retired from the office of vice-chairman of the board, which position has been abolished. Mr. Irvin will continue as a member of the board of directors and finance committee.

THE PYLE NATIONAL COMPANY, Chicago, has secured an exclusive license from the Burgess Battery Company, Madison, Wis., for the engineering, manufacturing and sale of its Multi-vent system of draftless ventilation for application to transportation equipment. Edward A. Sipp has returned to the Pyle-National Company as vice-president in charge of the Multi-vent division, after having spent the last three years in engineering and development work in connection with this system.

◆

C. R. MACBRIDE has been appointed manager of the engineering service department of the A. M. Byers Company, Pittsburgh, Pa., according to an announcement of M. J. Czarniecki, vice-president in charge of sales. Mr. MacBride has been transferred from the Boston, Mass., division sales office to assume his new duties. He was formerly in the service of the Edgewater Steel Company.

◆

THE CONSOLIDATED CAR-HEATING COMPANY, INC., Albany, N. Y., has elected new officers following the death of president Cornell S. Hawley. William S. Hammond, vice-president since 1912, and for 37 years connected with the company, is now president; John H. McElroy, secretary since 1917, and G. E. Oakley, for many years associated with the company, are vice-presidents; Frank M. Roos, purchasing agent and office manager, who has been with the company since 1910, is secretary and E. D. Ludlum, assistant treasurer, is treasurer.

◆

GEORGE V. CHRISTIE, vice-president in charge of sales of Waldvogel Brothers, Inc., New York, has resigned to become representative of the Gustin-Bacon Manufacturing Company, Kansas City, Mo., with headquarters in New York.

LYON MCCANDLESS has been appointed vice-president of the H. K. Porter Company, Pittsburgh, Pa., and B. D. Landes has been appointed general sales manager. Mr. McCandless is also vice-president of the Burgess Company, Inc., Beaver Falls, Pa. Mr. Landes was formerly manager of engineering service of the A. M. Byers Company, Pittsburgh.

Obituary

RALPH BROWN, district sales manager of the Adams & Westlake Company, Chicago, died in that city on April 4 of coronary thrombosis. Mr. Brown was born in Chicago on December 2, 1874, and as a young man entered the service of A. B. Pullman. Later he formed his own company for the sale of railroad supplies, and after several years entered the employ of the Barney & Smith Car Company, where he became general sales manager. He became affiliated with the Curtain Supply Company on July 1, 1916, and with the Adams & Westlake Company when it took over the former company.

Ralph Brown

◆

WILLIAM H. FOGARTY, SR., assistant vice-president of the Johns-Manville Corporation, with headquarters at Chicago, died of a heart ailment on April 9, in Evanston, Ill.

◆

E. L. LANGWORTHY, who was associated with the Adams & Westlake Company for over 50 years, during 30 of which he was eastern manager, died at his home in Philadelphia, Pa., on April 11, at the age of 84 years.

◆

PLINY FISK, financial backer in the organization of the American Locomotive Company, died of cancer in New York on March 30, at the age of 78. The son of a partner of the Civil War financial house of Fisk & Hatch, Mr. Fisk carried on the family's business as Harvey Fisk & Sons. In 1901, after conferences with the owners of the Rhode Island Locomotive Works as to consolidating a group of small locomotive builders into one large concern, he financed the incorporation of the American Locomotive Works with a capital stock of $50,000,000 to take over Rhode Island, Cooke (both owned by International Power Company), Brooks, Manchester, Pittsburgh, Richmond, Schenectady and Dickson, with a consolidated output capacity, based on 1900 volume estimated at more than 44 per cent of the country's total. Mr. Fisk became a director and member of the executive committee of the new company and was instrumental in persuading Samuel R. Calloway, then president of the New York Central & Hudson River, to head the consolidated firm.

Personal Mention

General

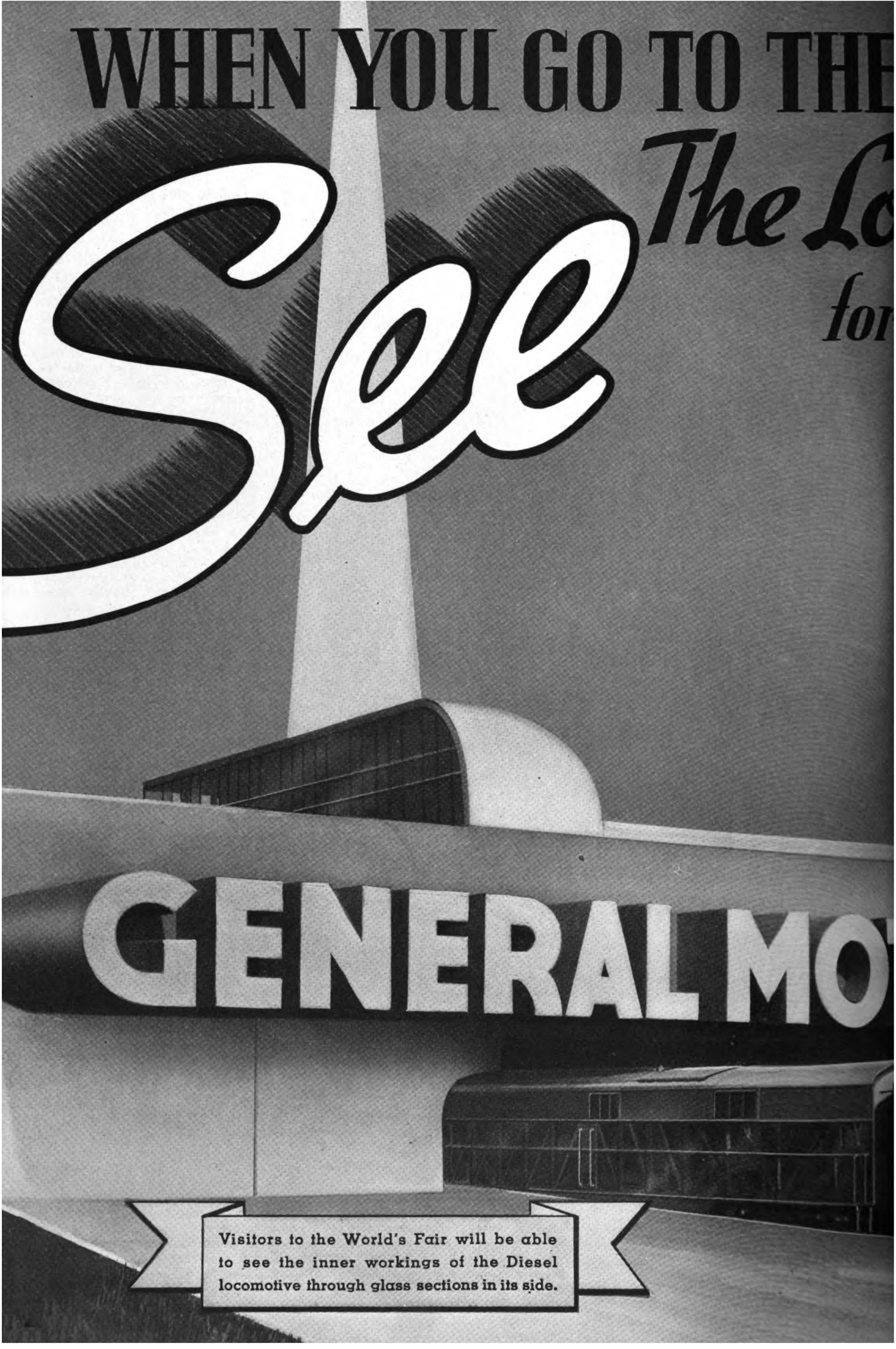
G. C. CHRISTY, whose appointment as general superintendent of equipment of the Illinois Central at Chicago, was reported in the April issue of the *Railway Mechanical Engineer*, was born at Holly Springs, Miss., in 1884, and entered railroad service as a helper in the paint shop of the Illinois Central at Water Valley, Miss., in 1898, while on vacation from school. Two years later he was transferred to the machine shop as an apprentice and, upon completion of his apprenticeship in March, 1904, he served until 1911 as a machinist and a foreman. In October of the latter year he was advanced to general foreman at Water Valley, and in December, 1914, was transferred to McComb, Miss. Mr. Christy was promoted to master mechanic of the Greenville and New Orleans division, with headquarters at Vicksburg, Miss., in July, 1917, and in 1926, his jurisdiction was extended to include the Vicksburg Route division. On November 1, 1929, he became superintendent of the car department, with headquarters at Chicago, and on November 1, 1937, was appointed superintendent of motive power.

G. C. Christy

FLOYD R. MAYS, whose promotion to general manager of the Illinois Central at Chicago, was announced in the April issue of the *Railway Mechanical Engineer*, was born at Crockett, Va., on August 28, 1879, and entered railway service at the age of fifteen as a machinist apprentice on the

Floyd R. Mays

(*Continued on second left-hand page*)


WHEN YOU GO TO THE
See
The Lo
for
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Visitors to the World's Fair will be able to see the inner workings of the Diesel locomotive through glass sections in its side.

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"THE WORLD OF TOMORROW"...

POWERED by 4-1000 horsepower General Motors 12-cylinder, 2-cycle, "V"-type Diesel engines, this locomotive has high starting tractive effort—smooth and rapid acceleration—and is capable of speeds up to 117 miles per hour. Overall length is 141 feet and weighs 605,000 pounds. Fuel capacity—2400 gallons; water capacity—2200 gallons.

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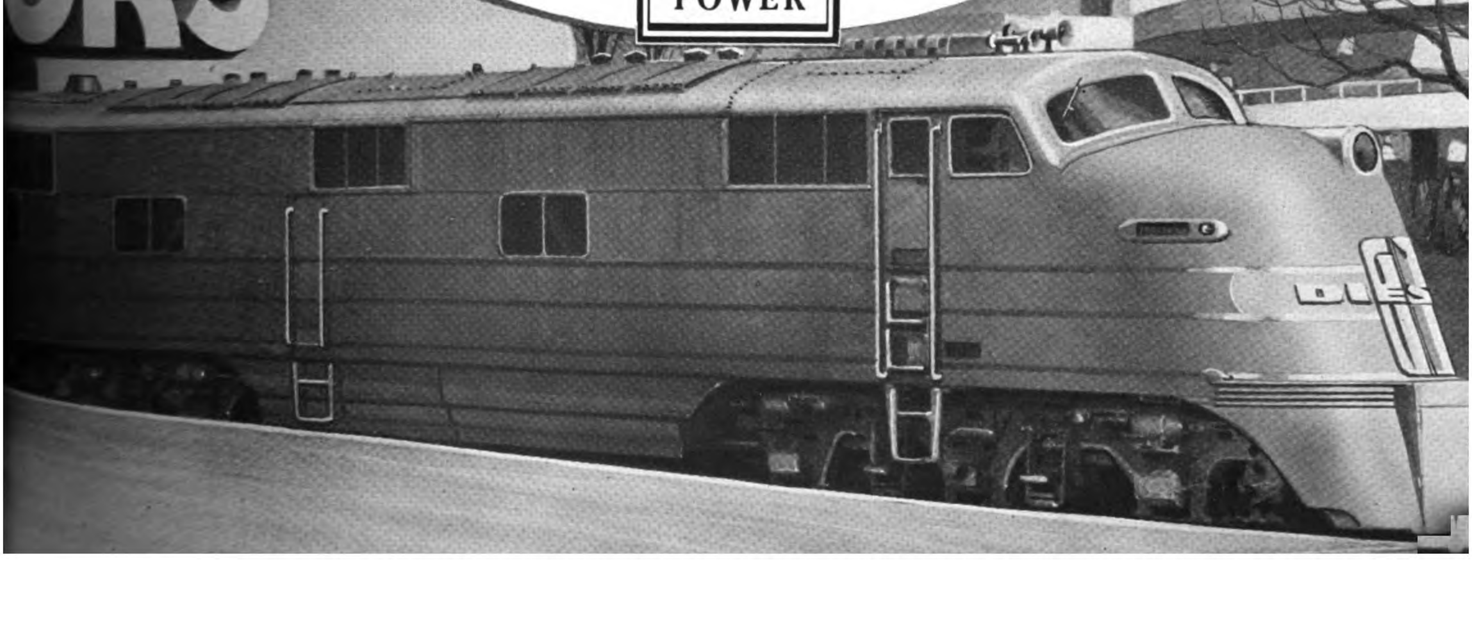

Norfolk & Western. Later, he was advanced to machinist and subsequently served in that capacity on the Southern at Salisbury, N. C., and Selma, Ala. On July 31, 1901, he became a machinist on the Yazoo & Mississippi Valley (now part of the Illinois Central) at Memphis, Tenn., and from October, 1901, to 1917, served successively as locomotive fireman, locomotive engineman, instructor on transportation rules, traveling engineer, assistant trainmaster, and trainmaster. On August 15, 1917, he was promoted to superintendent of the New Orleans division, with headquarters at Vicksburg, Miss., where he remained until April 1, 1923, when he was transferred to the Illinois division of the Illinois Central, with headquarters at Champaign, Ill. On January 1, 1926, Mr. Mays was advanced to general superintendent of the Y. & M. V., at Memphis, and on October 1, 1929, became general superintendent of motive power at Chicago. His title was later changed to general superintendent of equipment.

RAYMOND C. CROSS, master mechanic of the New York Central at Collinwood, Ohio, has been appointed assistant superintendent of equipment Lines West of Buffalo, with headquarters at Cleveland, Ohio, replacing A. D. Bingman. Mr. Cross was born in Cleveland, Ohio, on November 7, 1886, and entered the service of the

Raymond C. Cross

New York Central as a machinist apprentice at the Collinwood locomotive shop on July 1, 1901. In June, 1911, he was promoted to gang foreman at the Collinwood enginehouse. In November, 1911, he resigned to go with the Chicago Great Western as an enginehouse foreman. Four years later he returned to the New York Central and served at various points as terminal foreman until April, 1930, when he was promoted to the position of assistant master mechanic. He was appointed master mechanic at Collinwood in March, 1934.

A. D. BINGMAN, assistant superintendent of equipment of the New York Central, Lines West of Buffalo, with headquarters at Cleveland, Ohio, has been appointed superintendent of equipment with the same headquarters, succeeding J. Chidley, who has retired. Mr. Bingman was born at Jersey Shore, Pa., on April 12, 1885, and entered the service of the New York Central as a machinist at Avis, Pa., in June, 1909. He was promoted to piecework inspector in December, 1911, and in January, 1917, was advanced to engine terminal foreman. Mr. Bingman was promoted to the position of master mechanic at Utica, N. Y., on February 1, 1928, and was later transferred, successively, to Harmon, N. Y., and Rensselaer, N. Y. In the fall of 1932, he was appointed assistant master mechanic at Harmon, N. Y.; two years later, master mechanic at Albany N. Y., and on May 1, 1938, became assistant superintendent of equipment, Lines West of Buffalo, with headquarters at Cleveland.

C. H. EITEL, chief draftsman of the Central of Georgia, with headquarters at Savannah, Ga., has been appointed engineer of tests, succeeding A. P. Wells, deceased.

Master Mechanics and Road Foremen

L. P. WHITTINGHAM has been appointed assistant master mechanic of the New York Central, with headquarters at Collinwood, Ohio, succeeding S. T. Kuhn.

SHANNON T. KUHN, assistant master mechanic of the New York Central at Collinwood, Ohio, has been promoted to master mechanic with the same headquarters succeeding R. C. Cross.

Car Department

C. A. ABBOTT, car foreman of the Canadian National with headquarters at Edmonton N., Alberta, has retired.

FREDERICK J. IRVING has been appointed acting assistant foreman, car department, of the Canadian National at Campbellton, N. B.

JOSEPH H. BOUCHER has been appointed acting foreman, car department, of the Canadian National at Campbellton, N. B., succeeding R. Butler, retired.

Shop and Enginehouse

J. I. BROGDON, has been appointed assistant foreman, machine shop, of the Atlantic Coast Line at Waycross, Ga.

L. E. ATWELL, has become foreman of locomotive repairs of the Atlantic Coast Line at Waycross, Ga.

J. R. SMITH, has been appointed machine shop foreman of the Atlantic Coast Line at Montgomery, Ala.

W. S. HOLMAN, enginehouse foreman of the Atlantic Coast Line at Waycross, Ga., has become foreman of locomotive repairs, with the same headquarters.

P. M. KING, enginehouse foreman of the Atlantic Coast Line at Sanford, Fla., has been transferred to the position of enginehouse foreman at Montgomery, Fla.

R. O. WARD, a boilermaker in the employ of the Canadian National at Nutana, Sask., has been appointed acting boiler foreman, with headquarters at Melville, Sask.

DUNCAN CAMERON has been appointed acting day locomotive foreman of the Canadian National at Dartmouth, N. S.

GRANT MCLEAN has been appointed acting night locomotive foreman of the Canadian National with headquarters at Halifax, N. S.

W. L. MCGOWAN, gang foreman in the erecting shop of the Atlantic Coast Line at Tampa, Fla., has been transferred to Waycross, Ga., as general foreman.

F. M. ARRINGTON, erecting shop foreman at the Emerson shops of the Atlantic Coast Line, Rocky Mount, N. C., has been appointed night enginehouse foreman, with headquarters at Rocky Mount.

Obituary

M. J. HAYES, master mechanic of the Toronto, Hamilton & Buffalo, with headquarters at Hamilton, Ont., died at Atlanta, Ga., on April 8 while en route home from Florida.

ARTHUR P. WELLS, engineer of tests in the office of the superintendent of motive power of the Central of Georgia at Savannah, Ga., died in that city on March 27, after a long illness. Mr. Wells was born in Griffin, Ga., on December 15, 1872, and was a graduate in 1893 of the Georgia School of Technology. He became an apprentice in the shops of the Central of Georgia on October 23, 1893. He was later put in charge of the drafting department and was subsequently appointed engineer of tests.

PERSIFOR FRAZER SMITH, JR., former works manager of the Pennsylvania at Altoona, Pa., died at his home in Paoli, Pa., on April 5 after an illness of two months. Mr. Smith was born at West Chester, Pa., on August 1, 1870, and was graduated from Worralls Technical Academy, West Chester, Pa., in 1887. Following his graduation, he entered the service of the Pennsylvania as a special apprentice at the Altoona shops on October 24, 1887. He was appointed assistant road foreman of engines of the Pittsburgh division on February 1, 1892, and on August 1, 1893, was transferred in the same capacity to the "Fort Wayne Route" of the Pennsylvania, Lines West. Mr. Smith was promoted to assistant master mechanic of the Fort Wayne shops on February 1, 1895, and on November 10, 1896, was promoted to master mechanic in charge of the Crestline shops of the Toledo division. He was transferred to the Logansport, Ind., shops in the same capacity on January 1, 1900, to the Dennison, Ohio, shops on March 1, 1903, and to the Columbus, Ohio shops on August 1, 1906. On January 1, 1912, he was appointed superintendent of motive power of the Central system of the Pennsylvania, Lines West, and on January 1, 1917, became general superintendent motive power of the Pennsylvania, Lines West of Pittsburgh, with headquarters at Pittsburgh, Pa. On March 1, 1920, Mr. Smith was appointed works manager of the Pennsylvania in direct charge of the Altoona shops. On April 1, 1925, he was furloughed on account of ill health. On July 1, 1925, he became engineer of motive power on the staff of the chief of motive power and on December 1, 1931, was granted a leave of absence.

RAILWAY MECHANICAL ENGINEER

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office.

June, 1939

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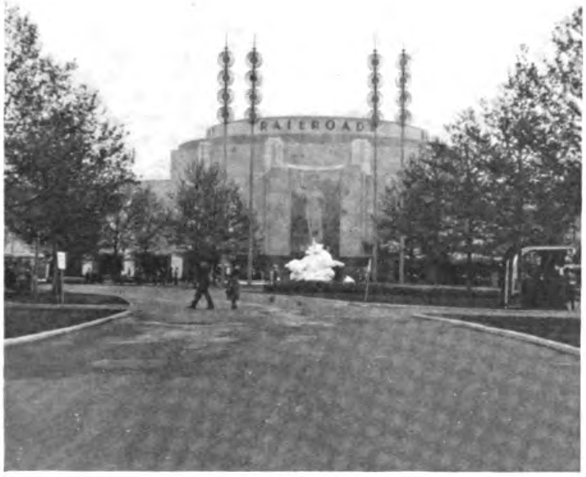

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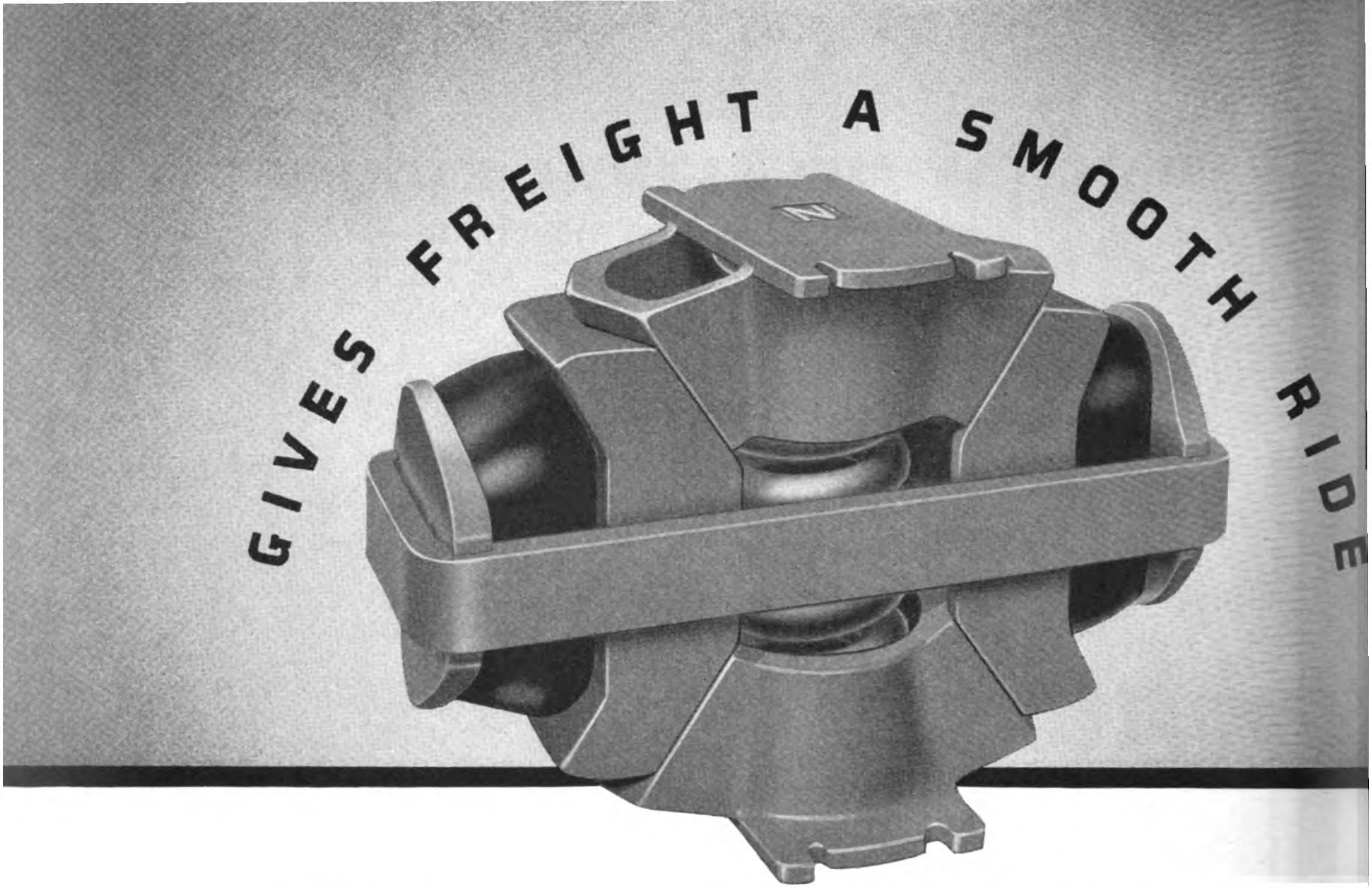

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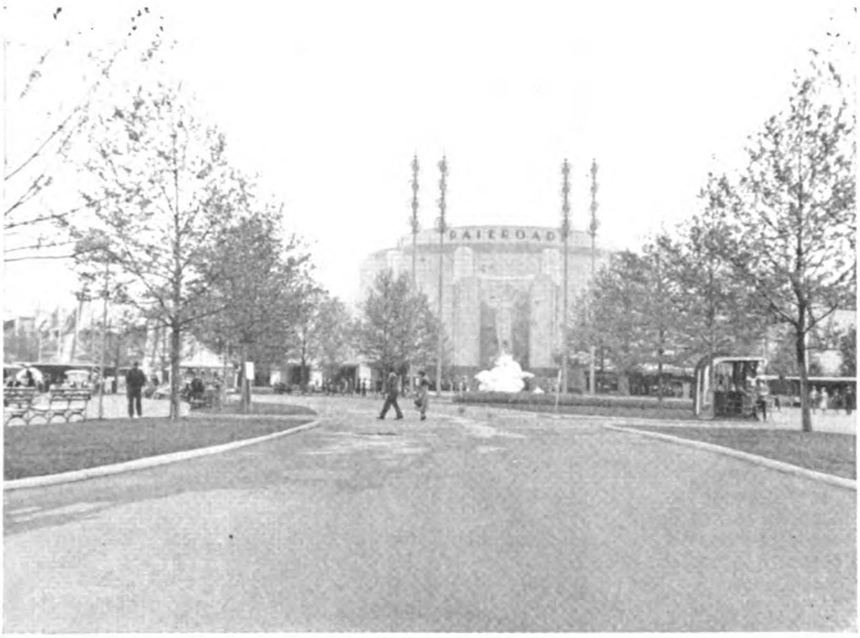
AMERICAN STEEL FOUNDRIES

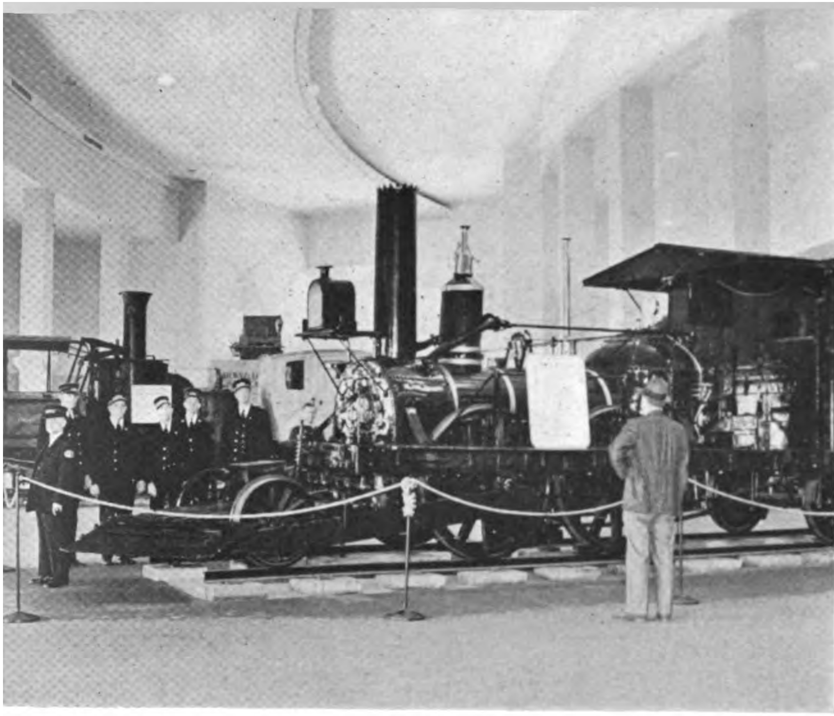
SIMPLEX ...The Long Lived SNUBBER

THE RAILROADS AT THE NEW YORK WORLD'S FAIR



Spread out over an area of 17 acres in the northwest corner of the New York World's Fair grounds is a group of exhibits which tell the story of the railroad industry from its pioneer days to the present time. At an expenditure estimated to be close to five million dollars, 27 railroads of the Eastern Presidents' Conference have collaborated in the building of the largest exhibit at the Fair.

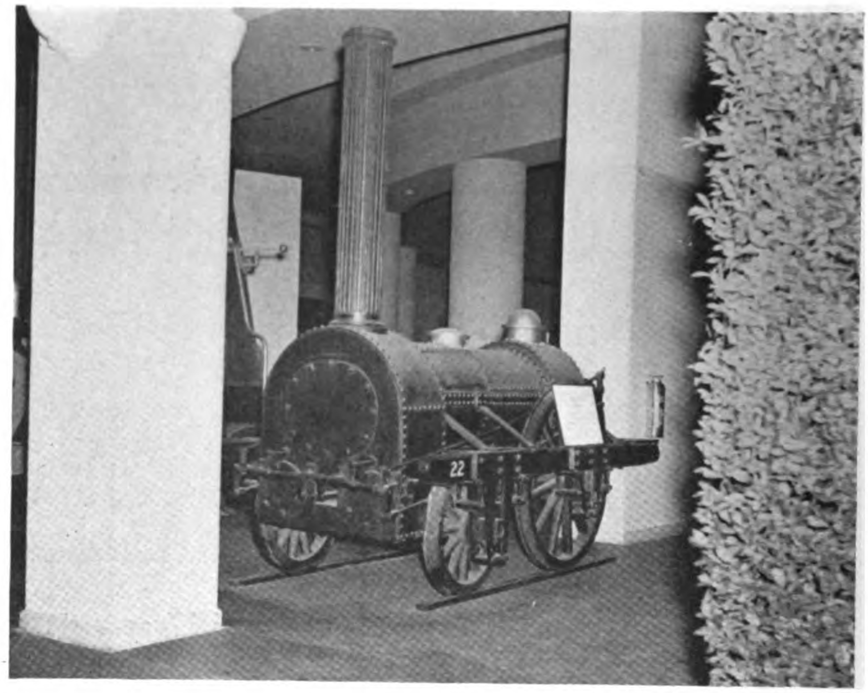
By the time the visitor has passed through the exhibit from the entrance of the Railroad Building to the last car and locomotive on the track he has seen a picture of the railroad business in its entirety. The rotunda contains, among many historical models, the originals of several locomotives that played an important part in early development. Then comes "Building the Railroads"; the yard exhibit of equipment used in the period from 1850 to 1900; the immense model railroad operation, "Railroads at Work;" the pageant of railroad history, "Railroads on Parade," and finally the track exhibits. The story of this show is told in pictures on the next 17 pages of this issue.

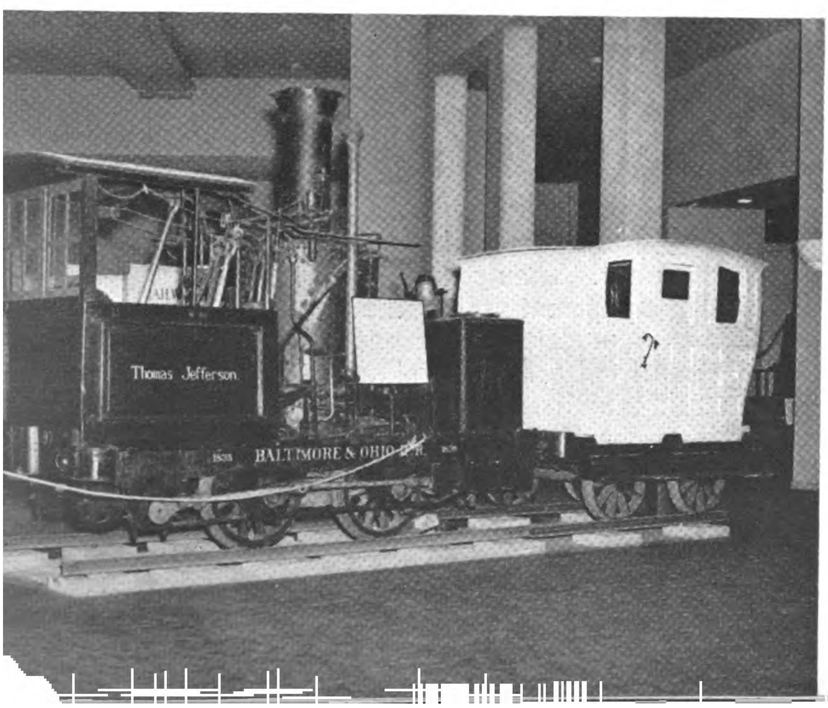


The "John Bull" is the oldest complete locomotive in America and was built by Robert Stephenson and Company, England, for the Camden and Amboy Railroad. The locomotive was completed in May, 1831, and shipped from Liverpool in July of that year. It was placed in service November 12, 1831

Photo by F. Allen Morgan

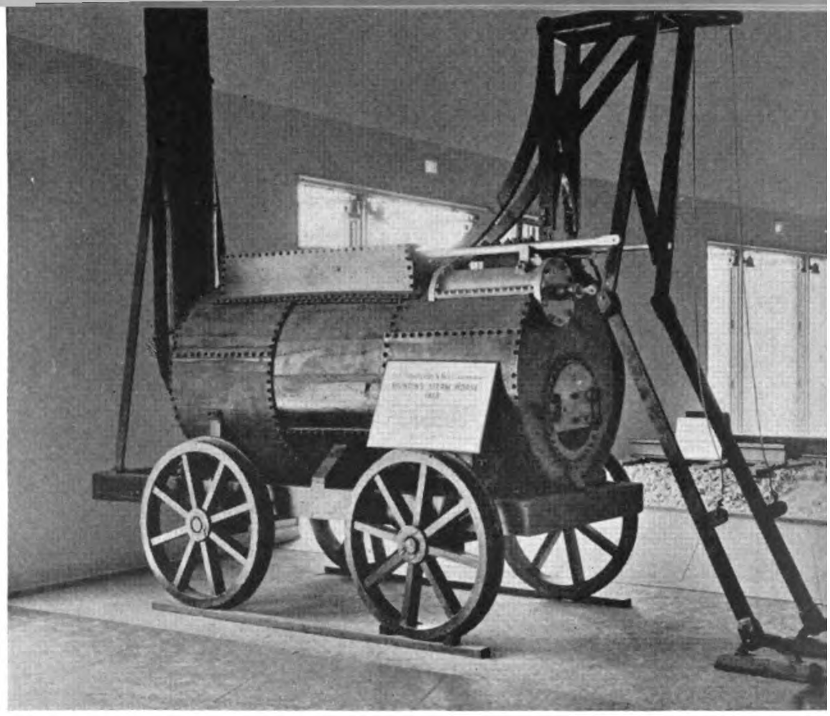
The Mercury—A 2-2-0 type English locomotive built about 1830 by George Stephenson embodying the best features of the Planet type locomotive which was popular at that time. This locomotive has one pair of drivers with a single pair of front wheels in main frame pedestals supported on springs

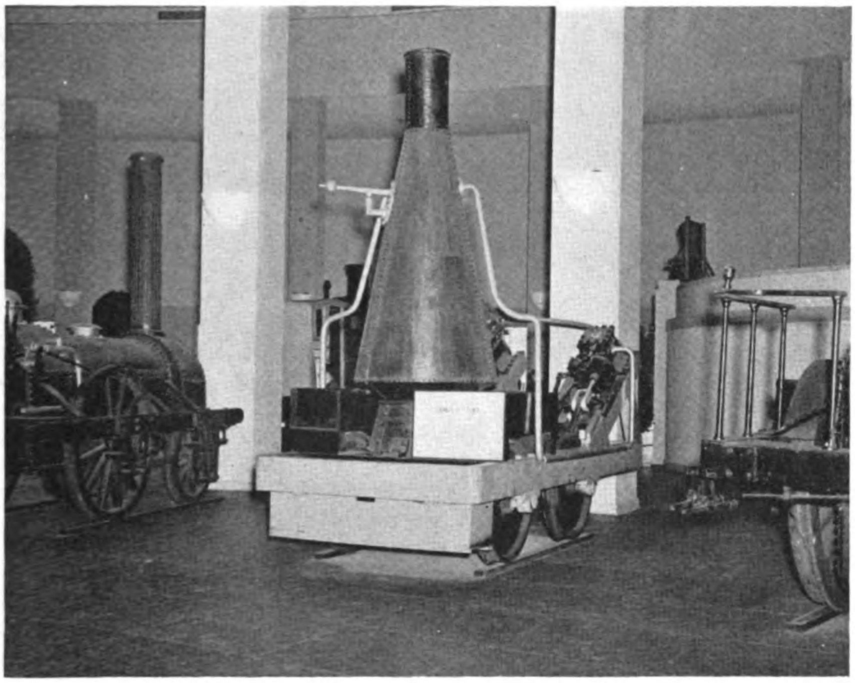




This early locomotive, the "Thomas Jefferson", taken from the Baltimore & Ohio historical collection was built by Davis & Gartner in 1834 and was in use until 1893. It was the first locomotive to operate in the State of Virginia (1835). The total weight is 28,900 lb.

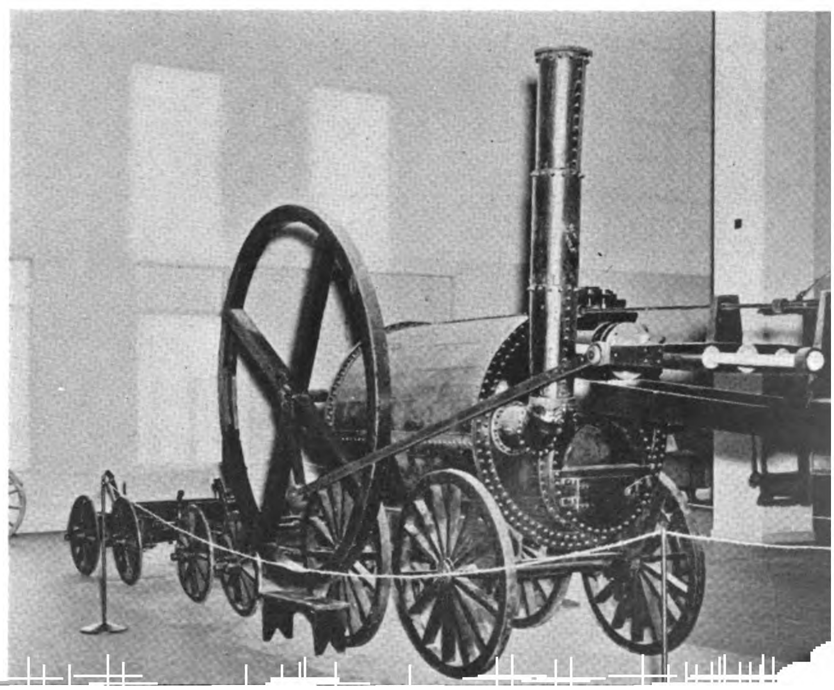
Brunton's Steam Horse, patented by William Brunton, an Englishman, in 1813. It is a horse-leg locomotive. The rear knuckle rods with their iron-shod feet are operated by horizontal cylinders like horses' legs to push the engine forward. Slow speed and lack of adhesion defeated the idea

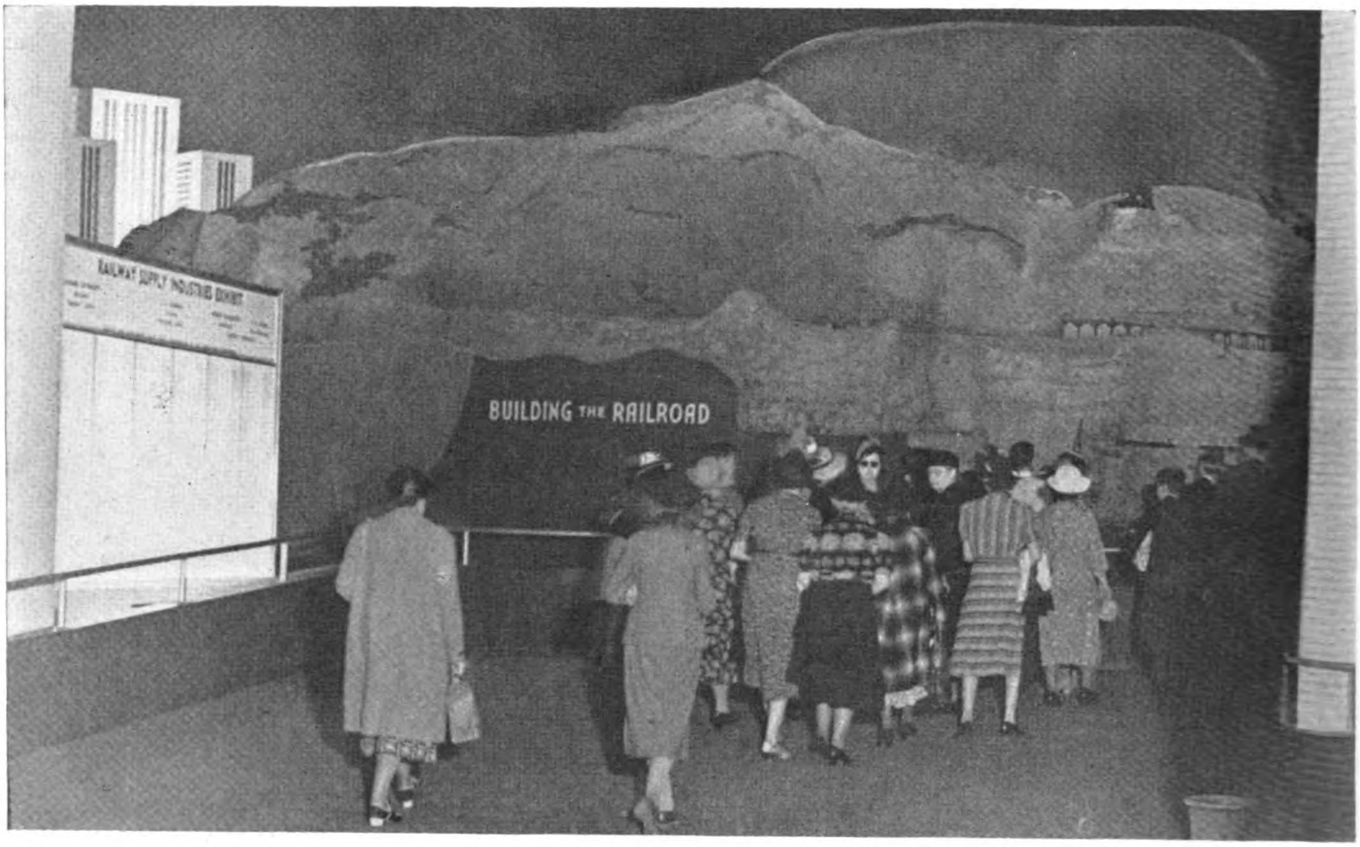


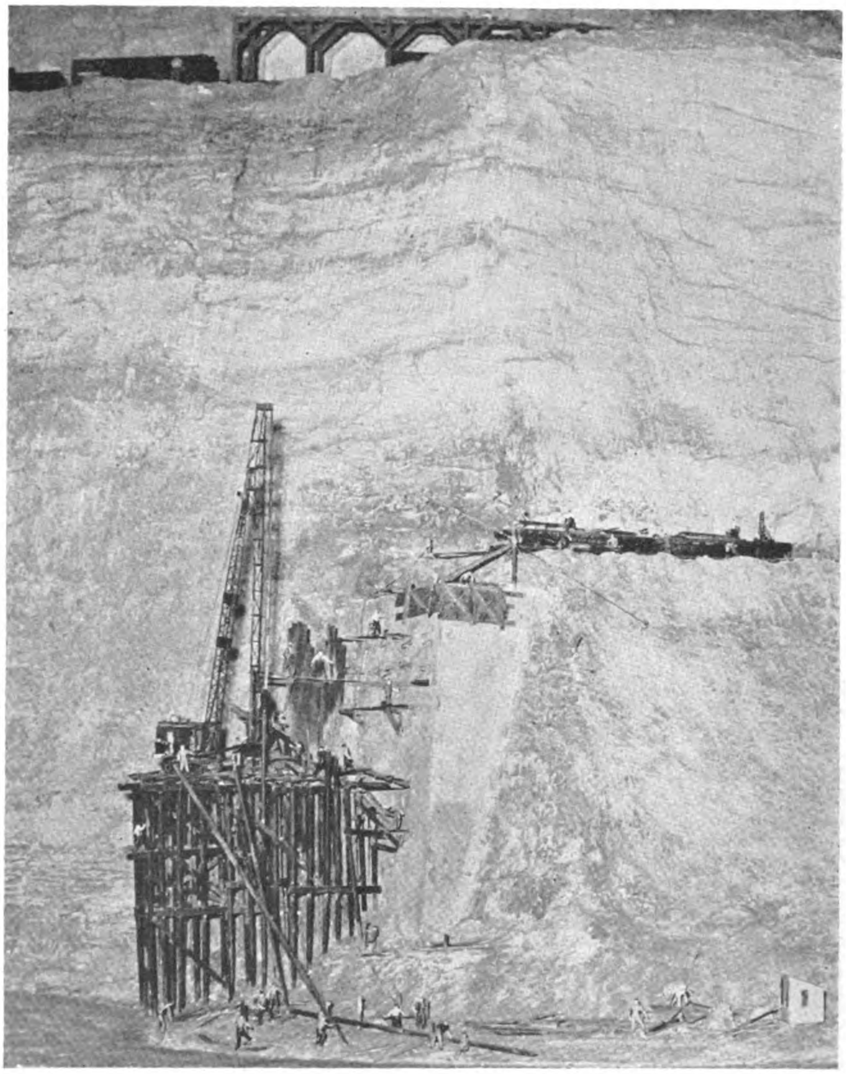


James II—A modification of an earlier engine employing a larger boiler, built by William T. James of New York in 1831. It employed inclined cylinders and was equipped with link-motion valve gear. It was purchased by the Baltimore & Ohio and was used until the latter part of 1836

Trevithick's Newcastle—Built by Richard Trevithick in 1805. This builder of stationary engines and advocate of higher boiler pressure built a number of models to demonstrate his theory. This locomotive was constructed and successfully operated at New Castle, England

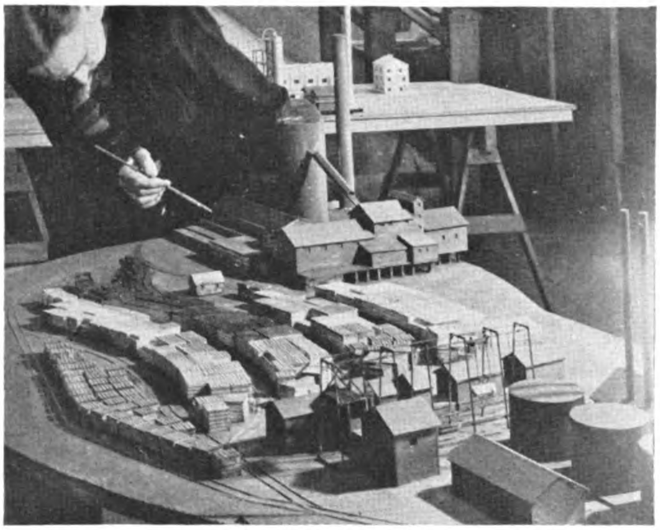


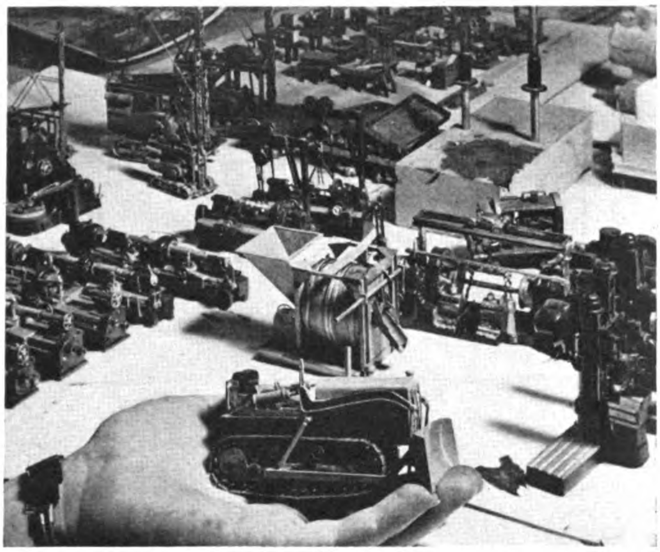

BUILDING THE RAILROAD
RAILWAY SUPPLY INDUSTRIES EXHIBIT

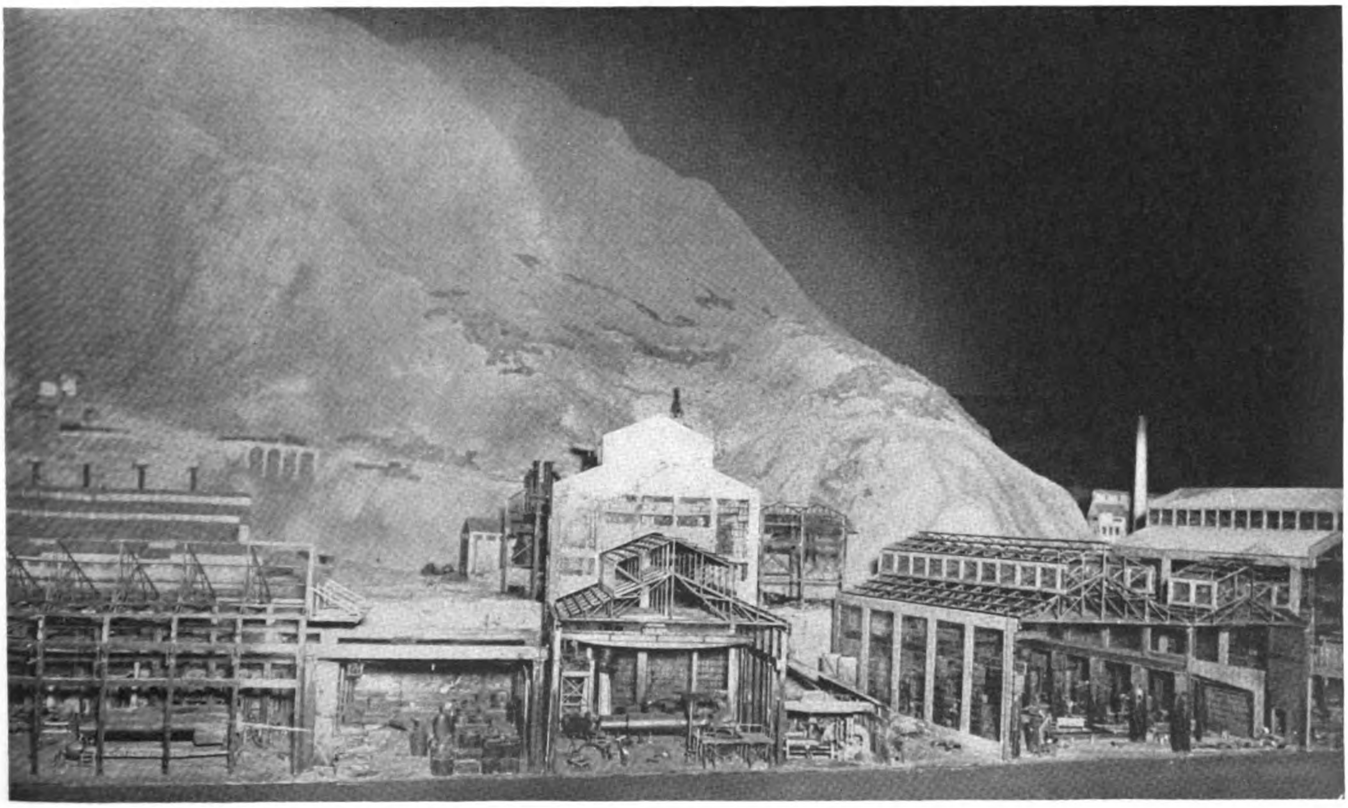


How Railroads Are Built

Under the dome of the railroad building the industries which supply the railroads, represented by 634 companies, have joined forces to erect an animated cyclorama, mountainous in design, which is 80 feet at the base and 28 feet in height. On this model is demonstrated the actual construction of a railroad and its equipment. As one enters the exhibit and walks up the circular ramp, at the base of the mountain, he sees first, in miniature, the construction of a roadbed, trestle and tunnels—all of which is illustrated with moving graders, pile drivers, cranes, etc. Beyond the dividing ridge in the mountain is located the locomotive shop, which is open to show the operations going on inside. Here are shown the various steps, from the casting of the beds to the setting of the "pops." Behind the shops are a miniature steel plant and rolling mill and an open pit ore mine with machinery in full operation. At the summit of the ramp the visitor may view the extraction and processing of railroad fuel and maintenance products in scattered model units. Along the immediate foreground, one may look into the insides of the passenger car building and repair shop and, further along, see the spot-system building of freight cars. These latter shops, for convenience in arrangement of the model, have been located in what will be recognized as the manufacturing zone of a large city, wherein are located accessory plants to show the production of glass, textiles, etc. All through the entire exhibit a complete railroad system operates, with its yards, signal systems, enginehouses, bridges, snow sheds, and tunnels. Freight and passenger trains rush by, first on tracks in the open and then through tunnels in the mountain. The ramp finally leads into the 10,000 square-foot area beneath the mountain where other exhibits supplement the story told on the outside







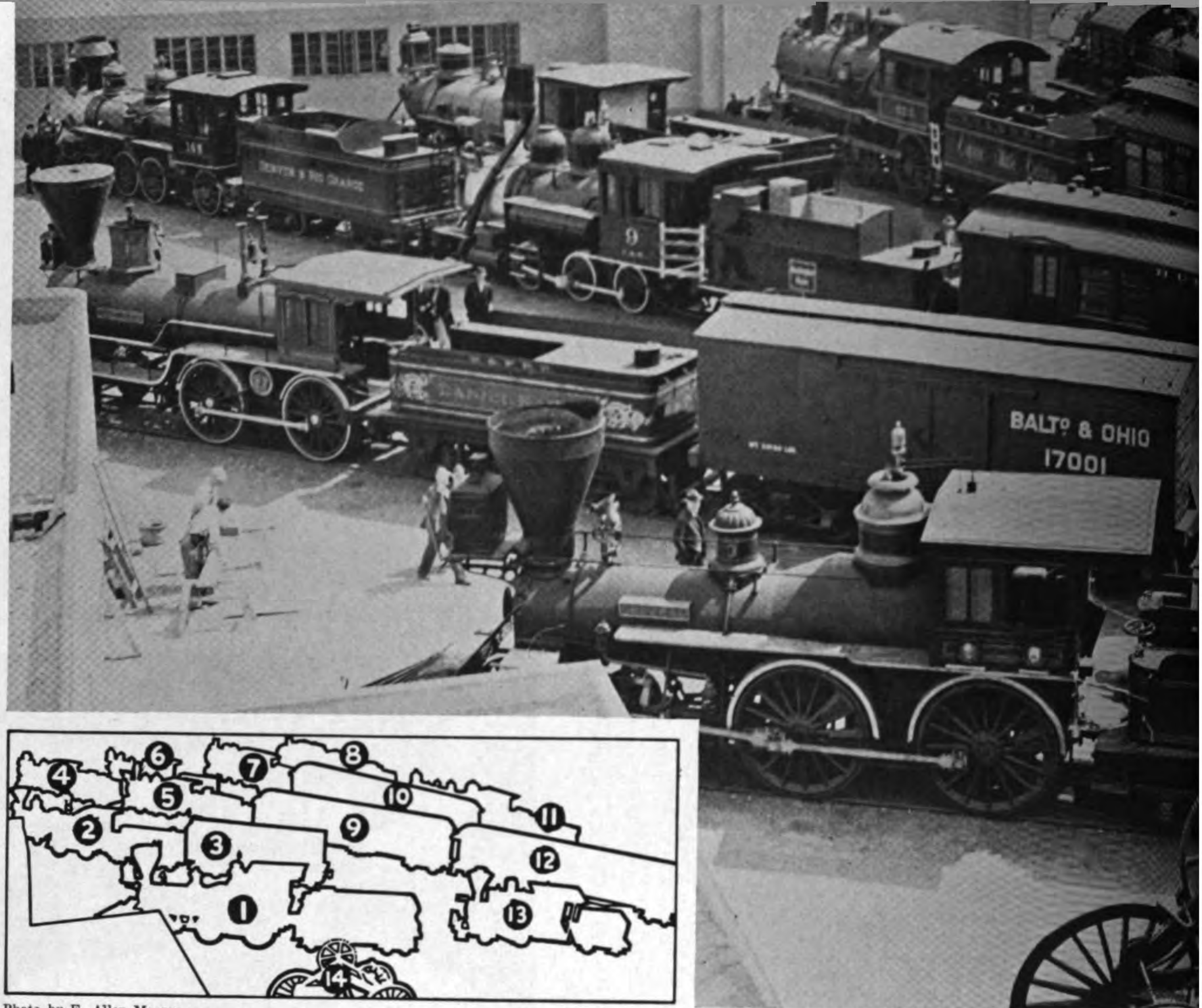
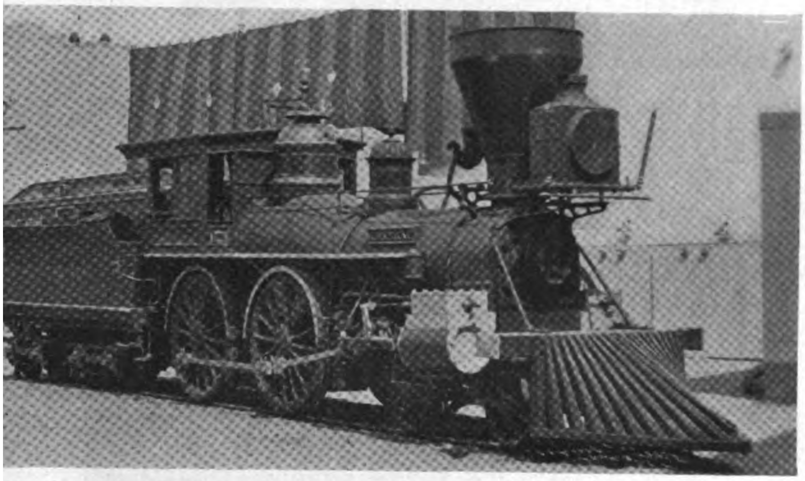
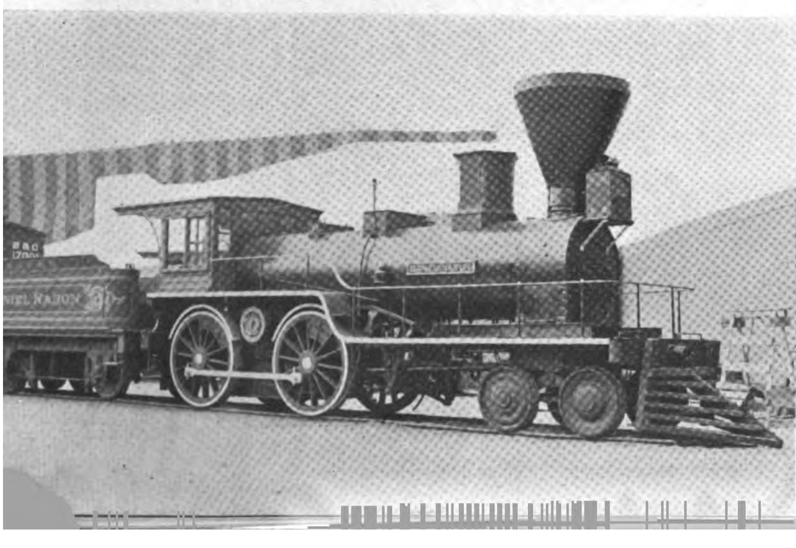
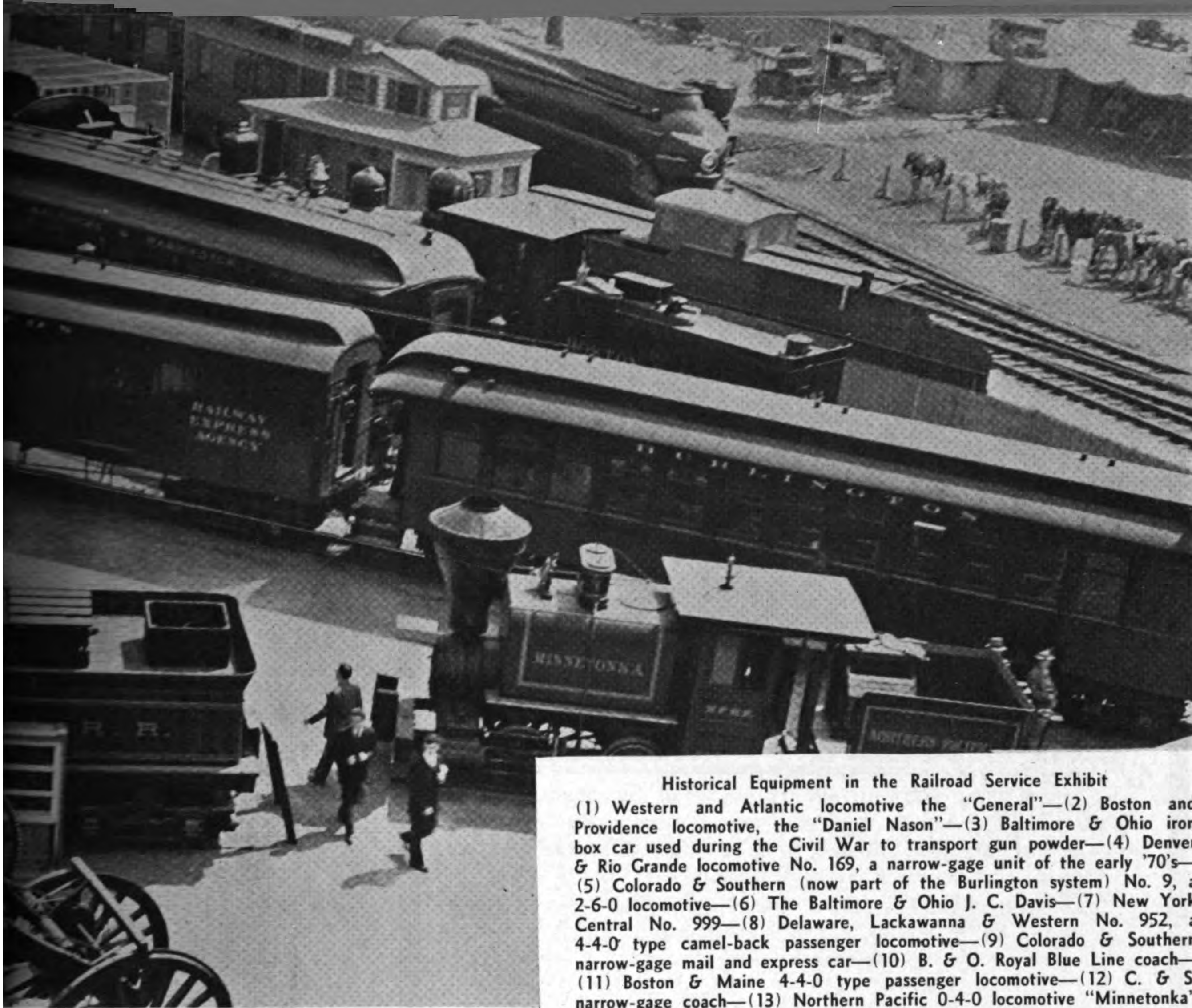


Photo by F. Allen Morgan



Left: The well-known "General" of the Western and Atlantic was involved in an historical and unusual episode of the Civil War just outside of Atlanta, Ga. It was stolen by a group of Union soldiers and ran for many miles before recapture by the Confederates—Lower left: The "Daniel Nason" was built in 1856 for the Boston & Providence (now part of the New Haven) and was named after a famous Maine sea captain; below—another view of the narrow-gage units in the yard area, numbered 4, 5, 9 and 12 in the large picture

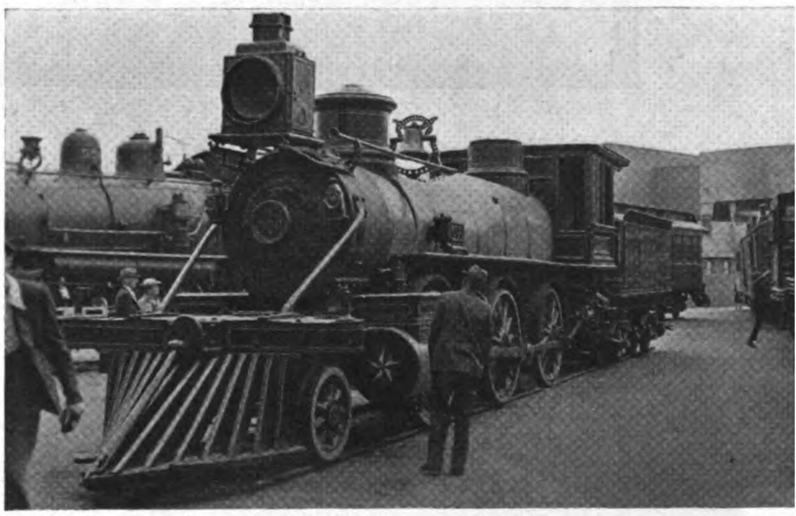


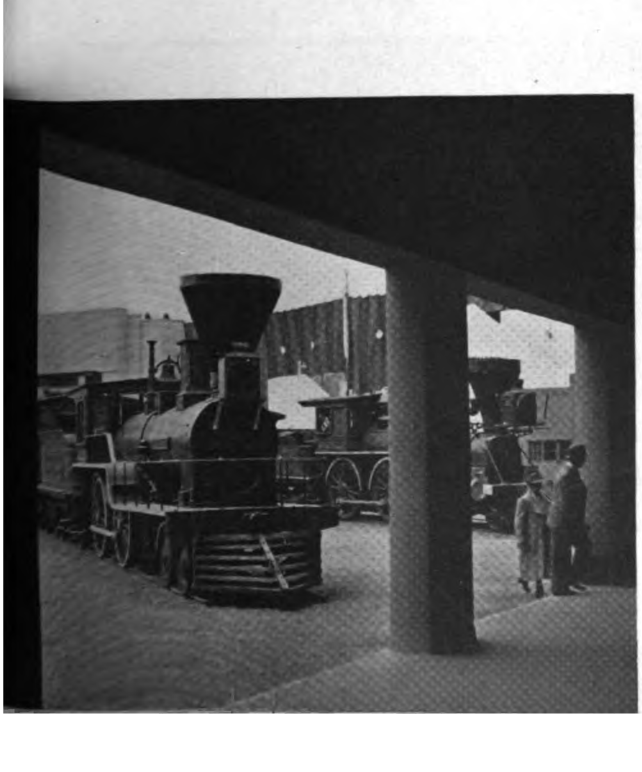


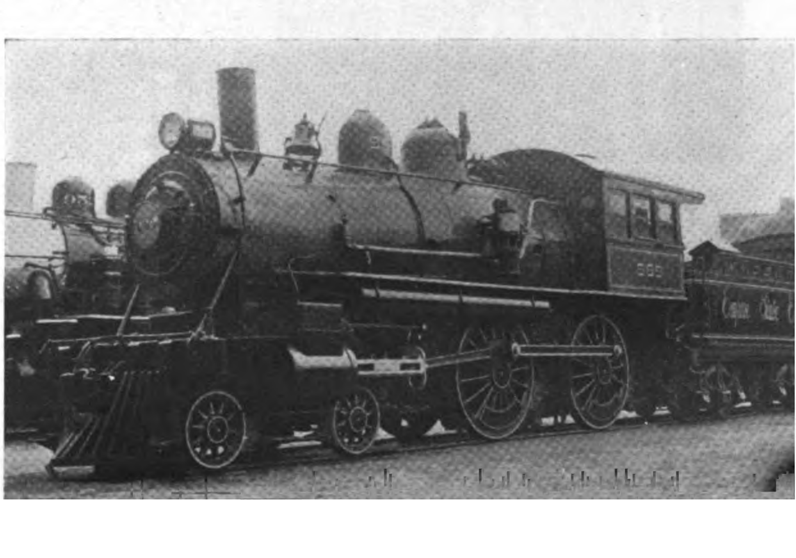
Historical Equipment in the Railroad Service Exhibit

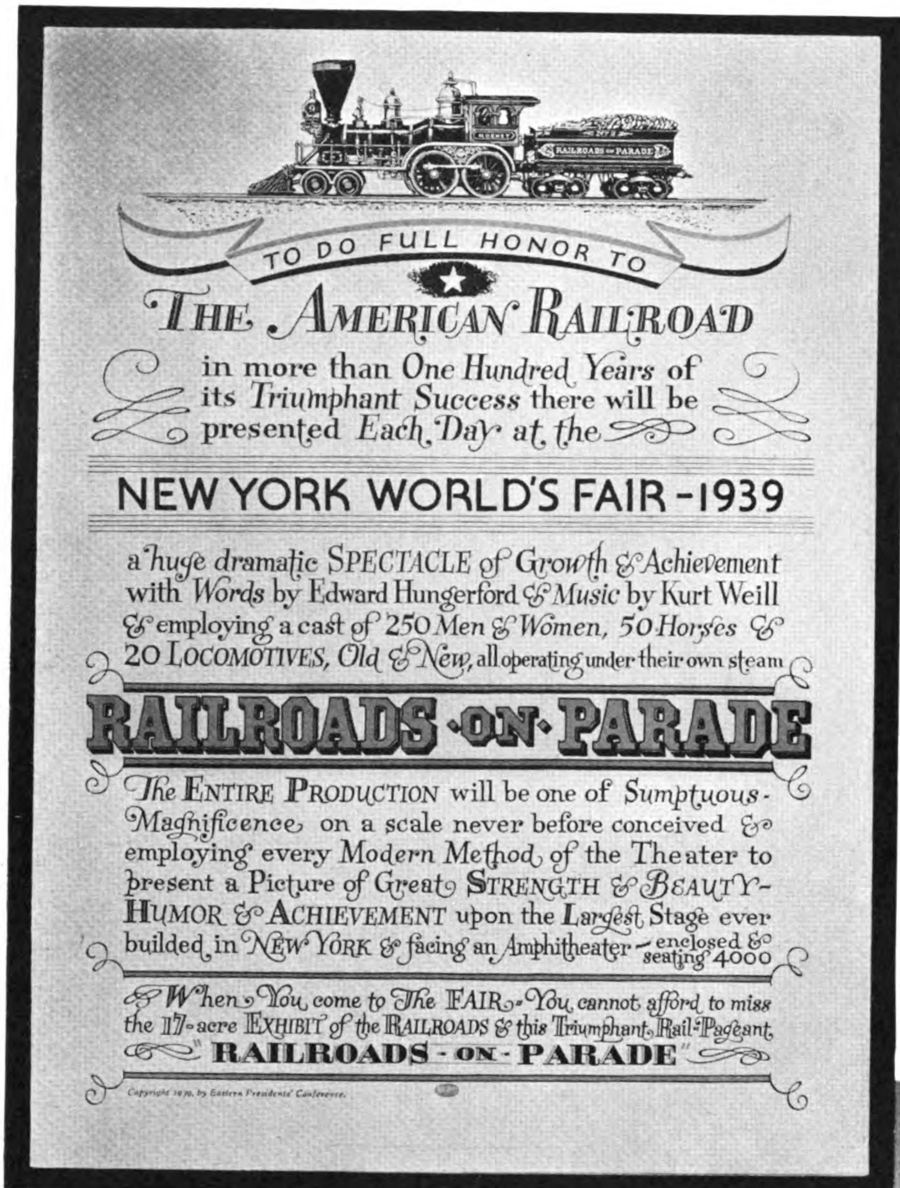
(1) Western and Atlantic locomotive the "General"—(2) Boston and Providence locomotive, the "Daniel Nason"—(3) Baltimore & Ohio iron box car used during the Civil War to transport gun powder—(4) Denver & Rio Grande locomotive No. 169, a narrow-gage unit of the early '70's—(5) Colorado & Southern (now part of the Burlington system) No. 9, a 2-6-0 locomotive—(6) The Baltimore & Ohio J. C. Davis—(7) New York Central No. 999—(8) Delaware, Lackawanna & Western No. 952, a 4-4-0 type camel-back passenger locomotive—(9) Colorado & Southern narrow-gage mail and express car—(10) B. & O. Royal Blue Line coach—(11) Boston & Maine 4-4-0 type passenger locomotive—(12) C. & S. narrow-gage coach—(13) Northern Pacific 0-4-0 locomotive "Minnetonka"

Right: Baltimore & Ohio 2-6-0 type locomotive "J. C. Davis" which was built in 1876 and acclaimed at the Centennial Exposition of that year the largest locomotive in the world—It weighs 153,000 lb.—Lower right: New York Central No. 999, built at West Albany in 1893 and piloted by Engineer Charles Hogan on a record-breaking run during which it is credited with attaining a speed of 112½ m. p. h. Other units not in the pictures are the Hannibal & St. Joseph mail car and a car used in 1827 at Quincy, Mass., for hauling granite



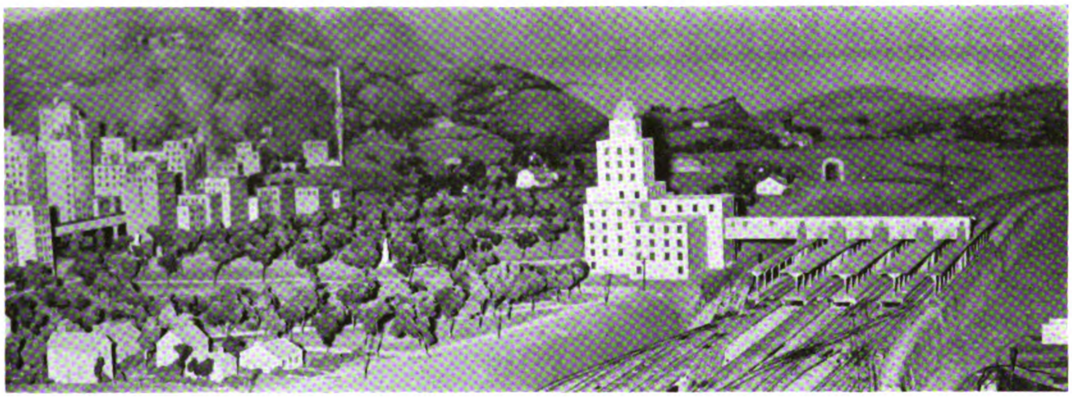





TO DO FULL HONOR TO
THE AMERICAN RAILROAD
in more than One Hundred Years of
its Triumphant Success there will be
presented Each Day at the
NEW YORK WORLD'S FAIR - 1939
a huge dramatic SPECTACLE of Growth & Achievement
with Words by Edward Hungerford & Music by Kurt Weill
& employing a cast of 250 Men & Women, 50 Horses &
20 LOCOMOTIVES, Old & New, all operating under their own steam
RAILROADS · ON · PARADE
The ENTIRE PRODUCTION will be one of Sumptuous
Magnificence on a scale never before conceived &
employing every Modern Method of the Theater to
present a Picture of Great STRENGTH & BEAUTY -
HUMOR & ACHIEVEMENT upon the Largest Stage ever
builded in NEW YORK & facing an Amphitheater - enclosed & seating 4000
& When You come to The FAIR - You cannot afford to miss
the 17-acre EXHIBIT of the RAILROADS & this Triumphant Rail-Pageant
"RAILROADS - ON - PARADE"


RAILROADS
ON PARADE
AND
RAILROADS
AT WORK
THIS WAY

In a building of its own, seating 1,000 persons, within the railroad building, skilled model builders have built a huge diorama and scenic setting. Over 1,000 buildings, in miniature, have been assembled to make the cities and towns in this 40-ft. by 160-ft. area through which a railroad system operates with 3,500 ft. of O-gage track, and 500 pieces of equipment, including 50 locomotives. The signal and control system required three million feet of wire. Performances are given every hour and last for 35 minutes. These show practically 24 hours of railroad operation under actual conditions of daylight and darkness



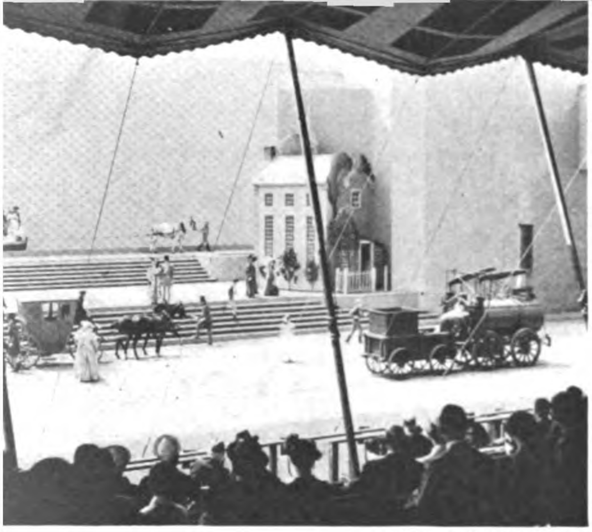


Photo by F. Allen Morgan

RAILROADS

This pageant of the railroads, a creation of Edward Hungerford, tells the story of transportation from the days of the covered wagon to the streamline trains of the present. The spectacle is presented on a three-level stage 250 ft. wide by 100 ft. deep. The fore-stage not only contains two standard-gage tracks adequate to support the largest modern locomotives but is paved with a gravel mixture to accommodate the horses and wagons which appear in the several scenes. Turntables, on the stage at either side, make rapid changes of scenery possible so that buildings, representative of the era of the scene, may form a part of the whole setting. Following the prologue—before the coming of the railways—Act I opens with a scene at the Battery in the City of New York upon the occasion of the opening of the Erie Canal, followed by the appearance of the first locomotive to run in America, the Delaware and Hudson's "Stourbridge Lion" (upper left), which made its debut at Honesdale, Pa., in August, 1829. In succession, as the show proceeds, appear the pioneer engines of the American railroad, the "Best Friend of Charleston," which ran on the South Carolina Railroad in 1830, the "De Witt Clinton" of 1831 (upper left, opposite page) and Peter Cooper's "Tom Thumb" (lower left, opposite page) which appeared in Baltimore in the spring of 1830. Act III opens up with a scene on the Overland Trail in 1849 and continues, in the second scene, with the occasion of President Abraham Lincoln leaving New York in February, 1861, on his way to the inauguration in Washington. Here appears the locomotive "William Crooks" and train, which enact the role of the Lincoln train. This locomotive recently made the trip from St. Paul, Minn., to the World's Fair at New York under its own steam. In the final scene of this act the locomotive "Genoa" (1871) of the old Virginia and Truckee Railroad appears for its contemporary, the "Jupiter" of the Central Pacific along with the No. 119 of the Union Pacific (these are shown in the lower left-hand picture on this page)

(Continued on opposite page)

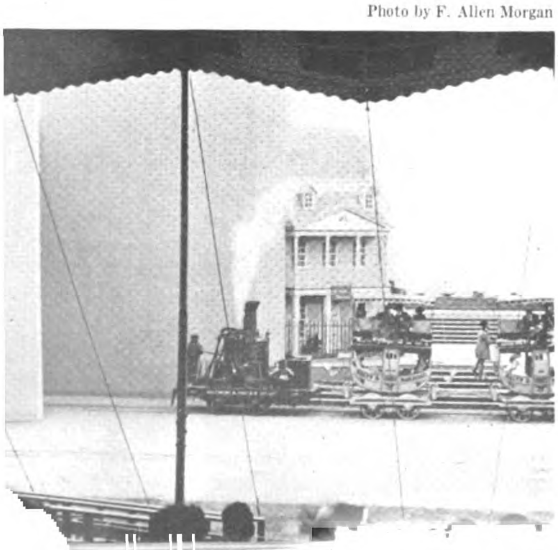
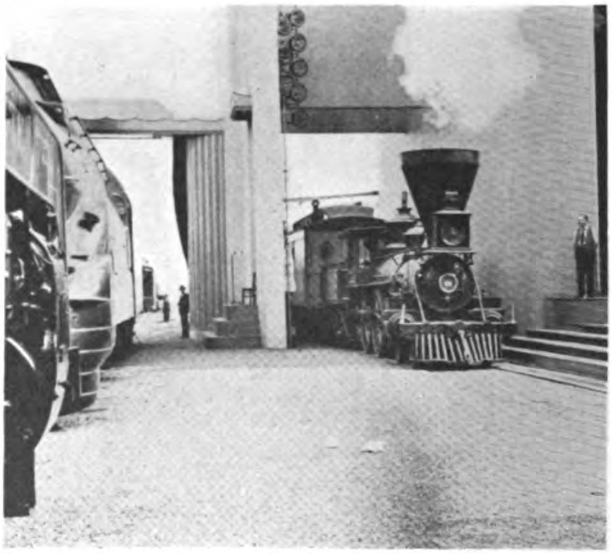
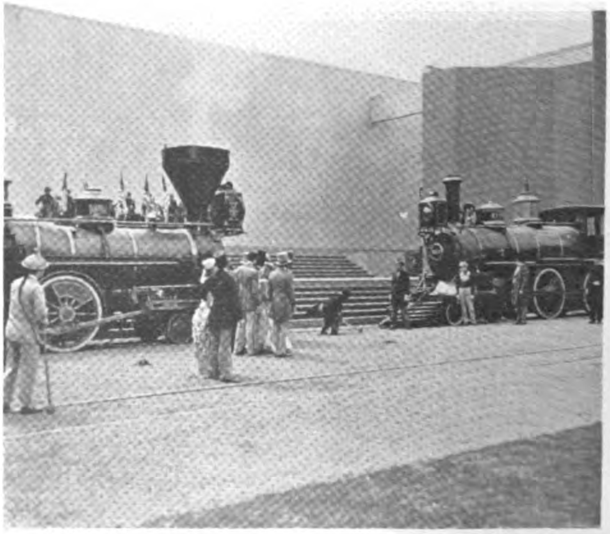


Photo by F. Allen Morgan





ON PARADE

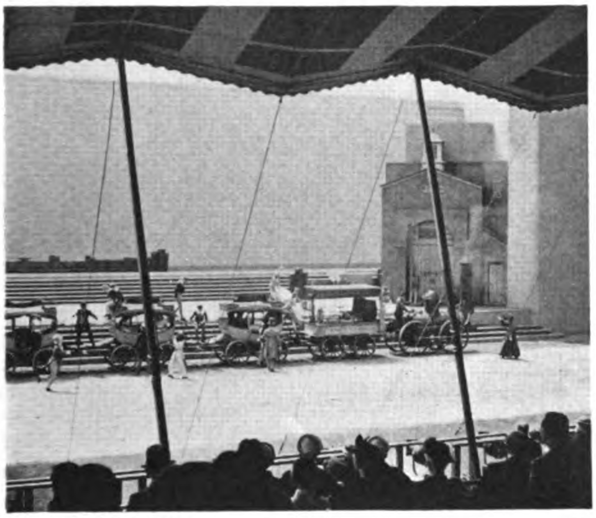
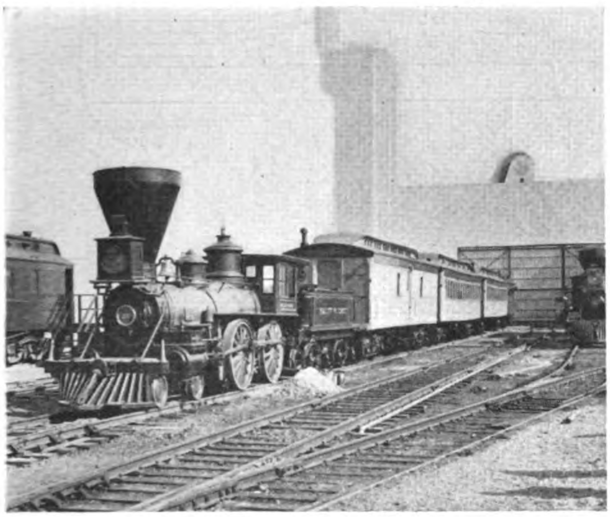
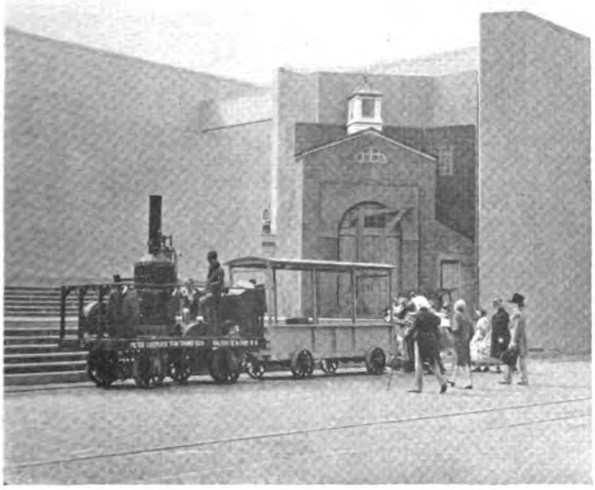
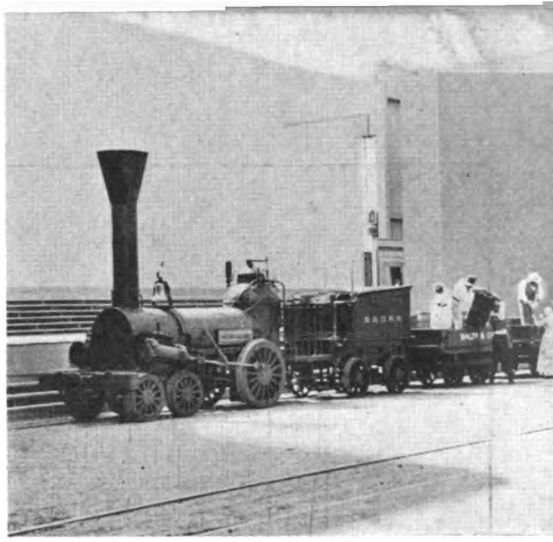
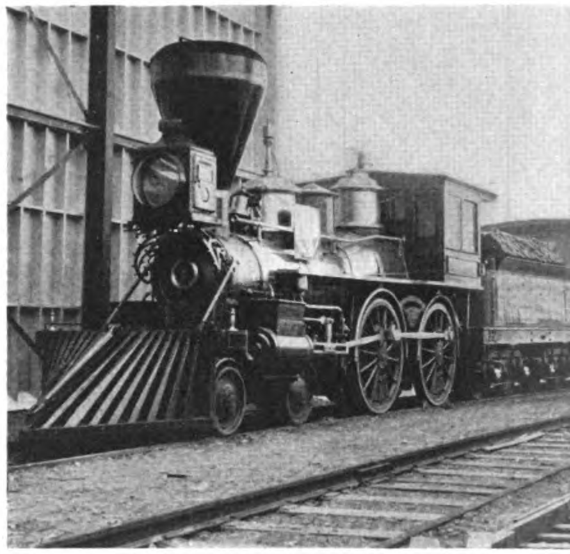


Photo by F. Allen Morgan

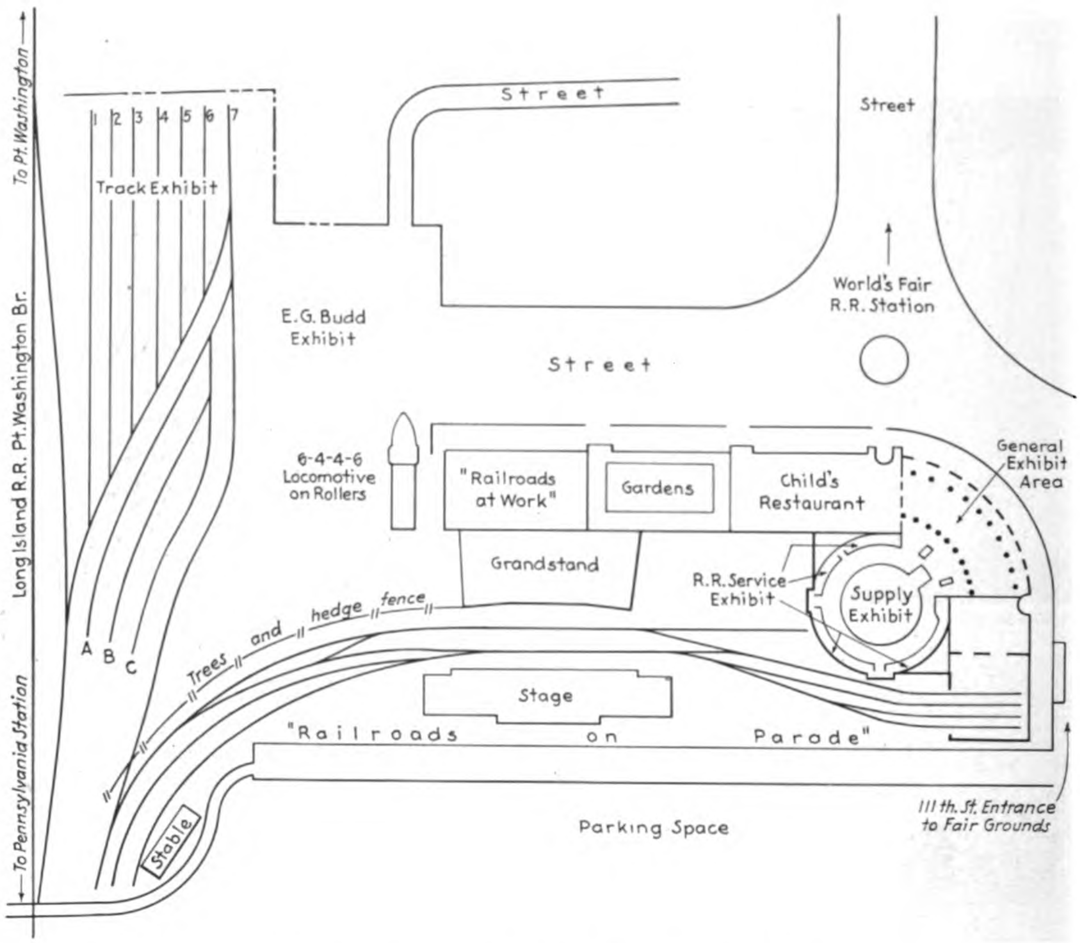








The first scene of the fourth act of the pageant is laid in the depot of almost any small American town of the '70s. The townspeople have gathered in force to await the arrival of the morning train, which, in this instance, is enacted by the Baltimore & Ohio's locomotive "Wm. Mason" and B. & O. cars. (While the picture of the actual scene does not appear on this page the locomotive and cars are shown in the center picture at the left.) This is followed by an old day coach of the '70s, the near side of which has been cut away to show the arrangement of its interior and the action of the players in the scene, drawn by the B. & O. locomotive "Thatcher Perkins" (upper right, opposite page). Other historical locomotives which appear in the show are the B. & O. "Atlantic" (1832), the "J. W. Bowker" (1875), and the Ross Winans" 1869. Toward the close of the pageant the Pullman Company's lounge car "Luxuryland" takes part in a scene developed to show the comfort and convenience of modern travel and, at the very end, two of the latest steam locomotives are run onto the stage from either side and come to a stop, pilot to pilot, at the center. These modern examples of passenger power are selected from the equipment of the Eastern railroads and are changed from month to month. During the month of May the restyled Delaware, Lackawanna & Western 4-6-4 type No. 1939 and the Pennsylvania streamlined Pacific No. 3768 were used to ring down the curtain on the 45-min. show. During June the New York Central's "Commodore Vanderbilt," a streamline Hudson type, teams up with the Pennsylvania No. 3768. July and August will feature the Canadian locomotives which drew the royal train



DIRECTORY OF EXHIBITS ON THE TRACKS

Track 1

London, Midland & Scottish train, "Coronation Scot". (Locomotive and eight passenger cars.)
New York Central mail car No. 4868.

Track 2

Italian State Railways
- Three-car electric train—express service.
- Two-car electric train—local service.
- Gasoline-engine-powered rail car.
- Road-rail freight-car transport truck.

Track 3

New York Central class J3a (4-6-4 type) locomotive, No. 5453.
N. & W. articulated passenger locomotive, No. 1206.
General American Transportation Corporation all-welded box car, No. 1940.
General American Transportation Corporation 10,000-gal. tank car, No. 1940.
Erie automobile car, No. 96999, with auto loading racks
N. & W. 55-ton hopper car, No. 38288.
D. & H. all-welded hopper car No. 4651.

Track 4

P. R. R. class M1a (4-8-2 type) locomotive, No. 6759.
D. L. & W. 70-ton cement car, No. 1939.
Lackawanna refrigerator car, No. LRX1939.
Bangor & Aroostook box car, No. 4566.
Nickel Plate box car, No. 87066.
C. & O. gondola, No. 44724.
Lehigh Valley caboose, No. 95065.

Track 5

P. R. R. electric locomotive, Class GG1, No. 4888
P. R. R. stock car, No. 134124.
P. R. R. hopper car, No. 676314.
P. R. R. depressed-well flat car, No. 470090.
P. R. R. flat car, No. 470200.
P. R. R. flat car, No. 474415.

Track 6

B. & O. passenger locomotive "George H. Emerson", (4-4-4-4 type), No. 5600.
B. & O. covered-wagon box car, No. 380164.
B. & O. cement car, No. 630200.
B. & O. caboose, No. C-2502.

Track A

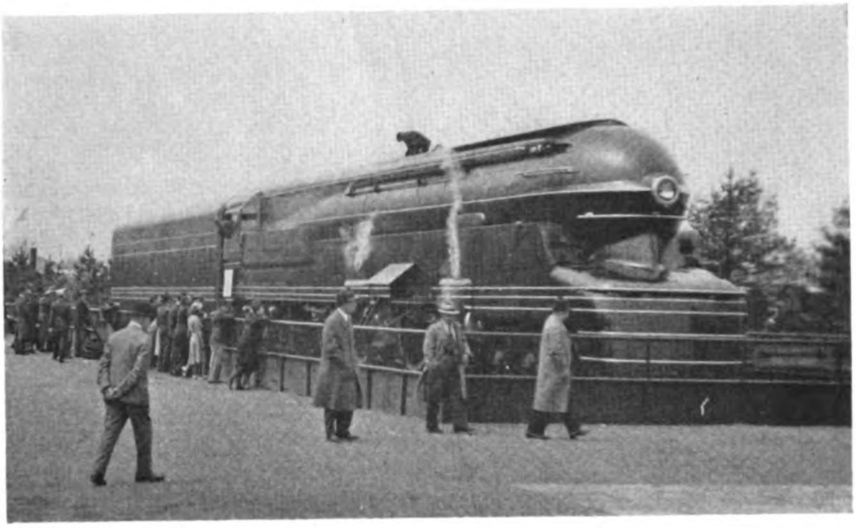
Pullman Company
- Light-weight room-observation sleeping car
- Light-weight Roomette sleeping car
- Light-weight duplex bedroom car.
- Standard section room sleeping car.
- Tourist section sleeping car.

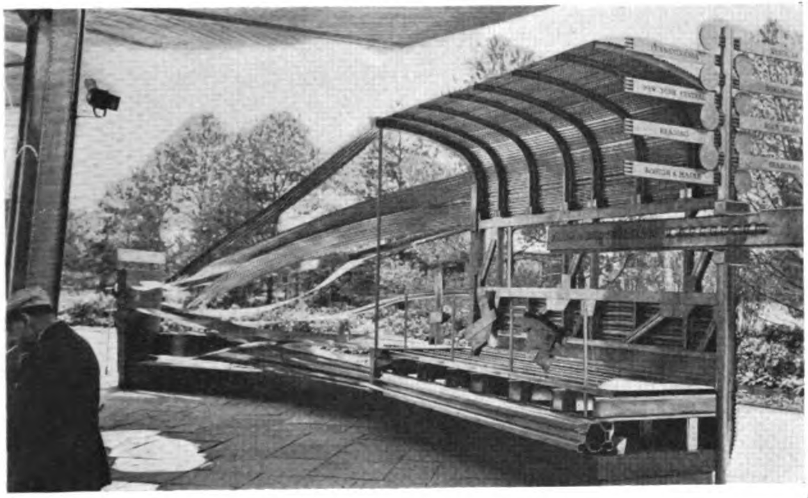
Track B

P. R. R. horse express car, No. 5824.
New Haven coach, No. 8501.

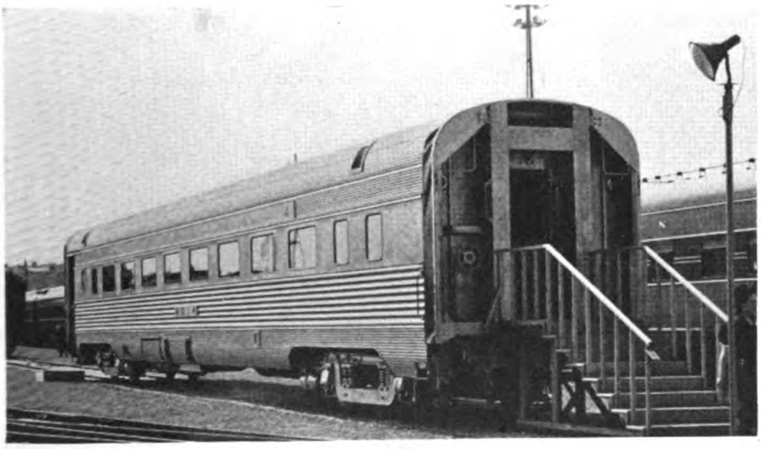
Track C

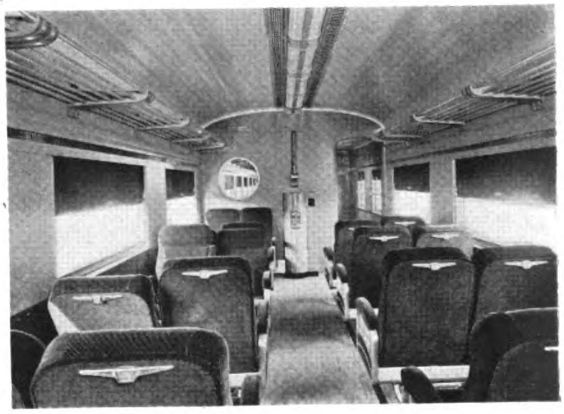
P. R. R. coach 4014.
New York Central diner-lounge car, No. 535.

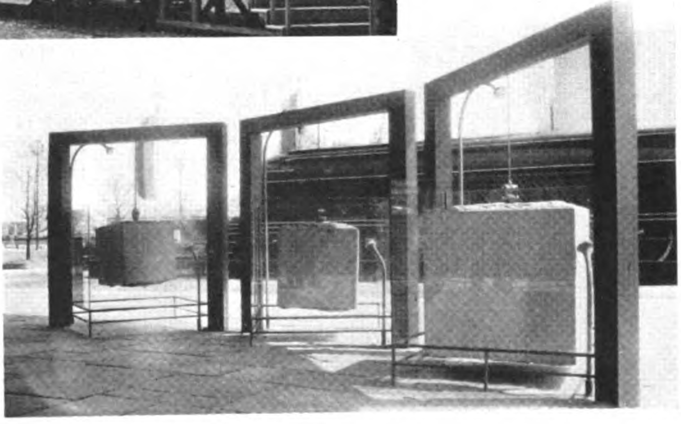




At the top is the new "American Railroads" 6-4-4-6 type locomotive which is operating under steam on a specially-designed roller "test stand" in which the power developed at the main drivers is used to generate the electrical energy which operates the truck wheels under the tender by means of traction motors. The engine truck wheels are belt-driven from main-driver rollers. At the left and below are four scenes in the Budd exhibit. Of these, the top is a portion of a longitudinal section of a Budd Shotweld passenger coach with the display arranged to show the method of forming the shapes from the strip stock. The two pictures in the center, below, are the exterior and interior of a Budd coach recently completed for the Pennsylvania. Bottom—A display designed to show the comparative strength of materials

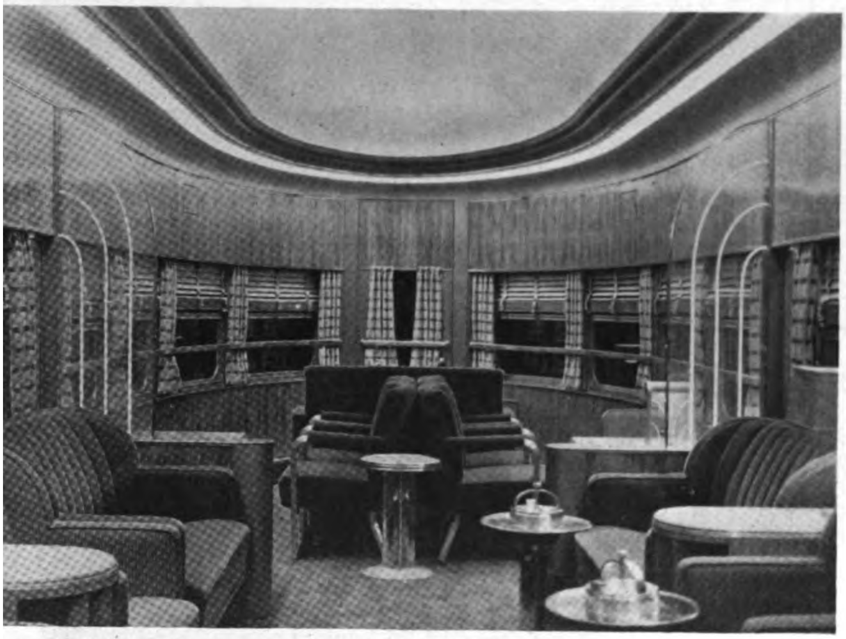


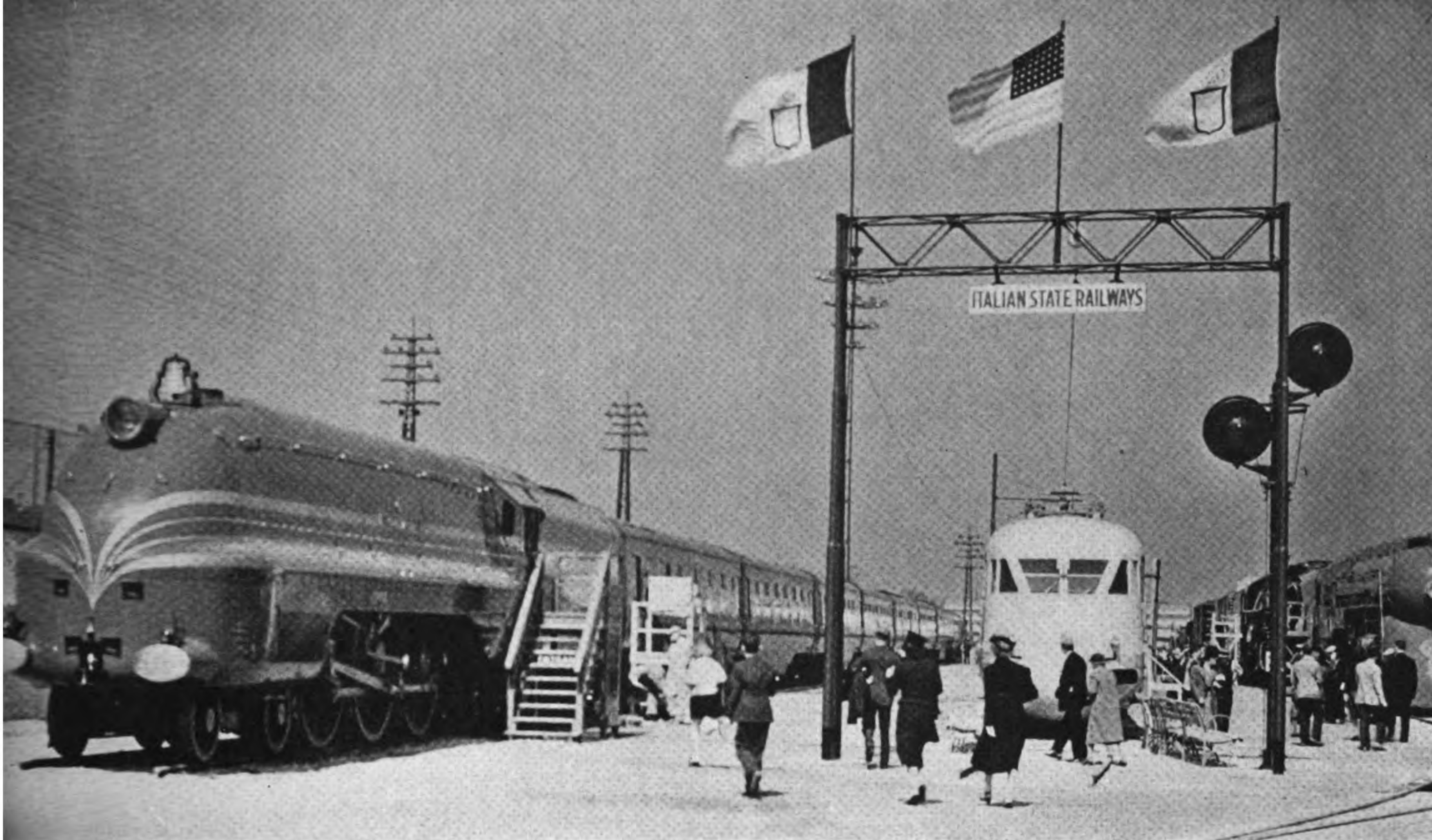


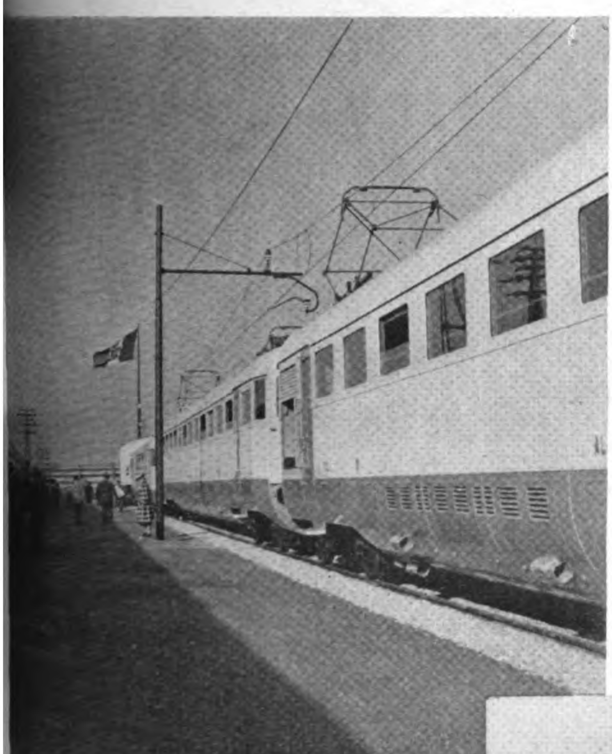


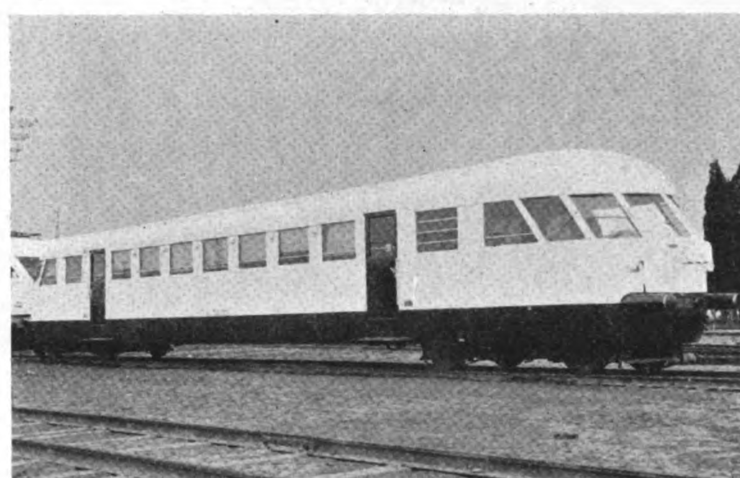
The Pullman Train

The four pictures on this page are scenes at the Pullman exhibit where five cars make up a train through which several thousand visitors are passing daily. The outstanding car in this exhibit is the room-observation sleeping car which represents the last word in Pullman accommodations. The two interior views below give an idea of the luxurious appointments of the observation end of this car. Two other cars in the Pullman train are the Roomette sleeping car similar to that exhibited in Atlantic City in 1937 and a duplex bedroom car. All three of these cars are of lightweight construction. A standard section, room sleeping car and a tourist section sleeping car complete the train. Below is the "sun-deck" at the middle of the train



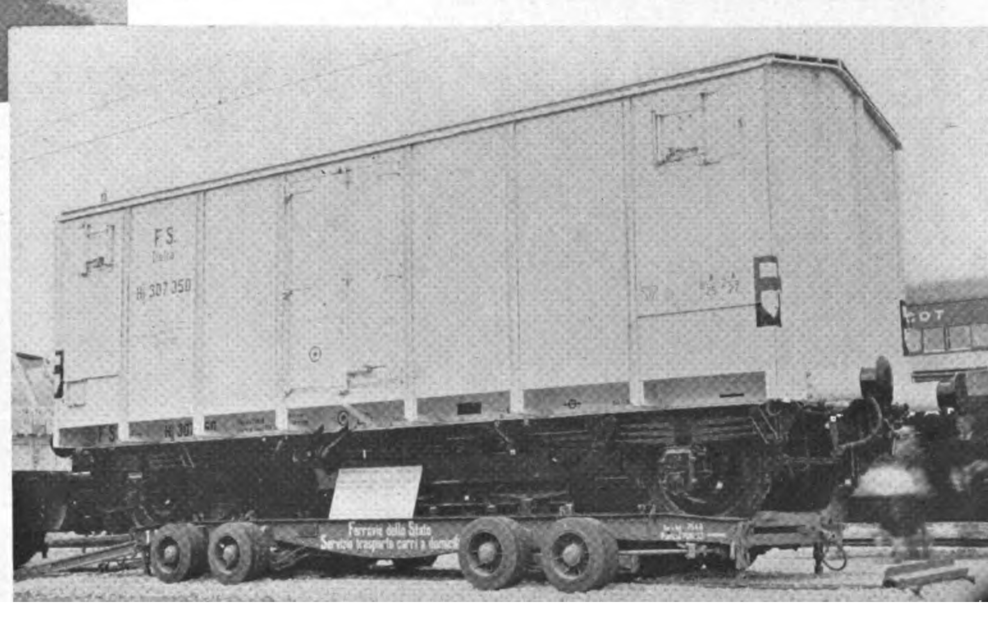


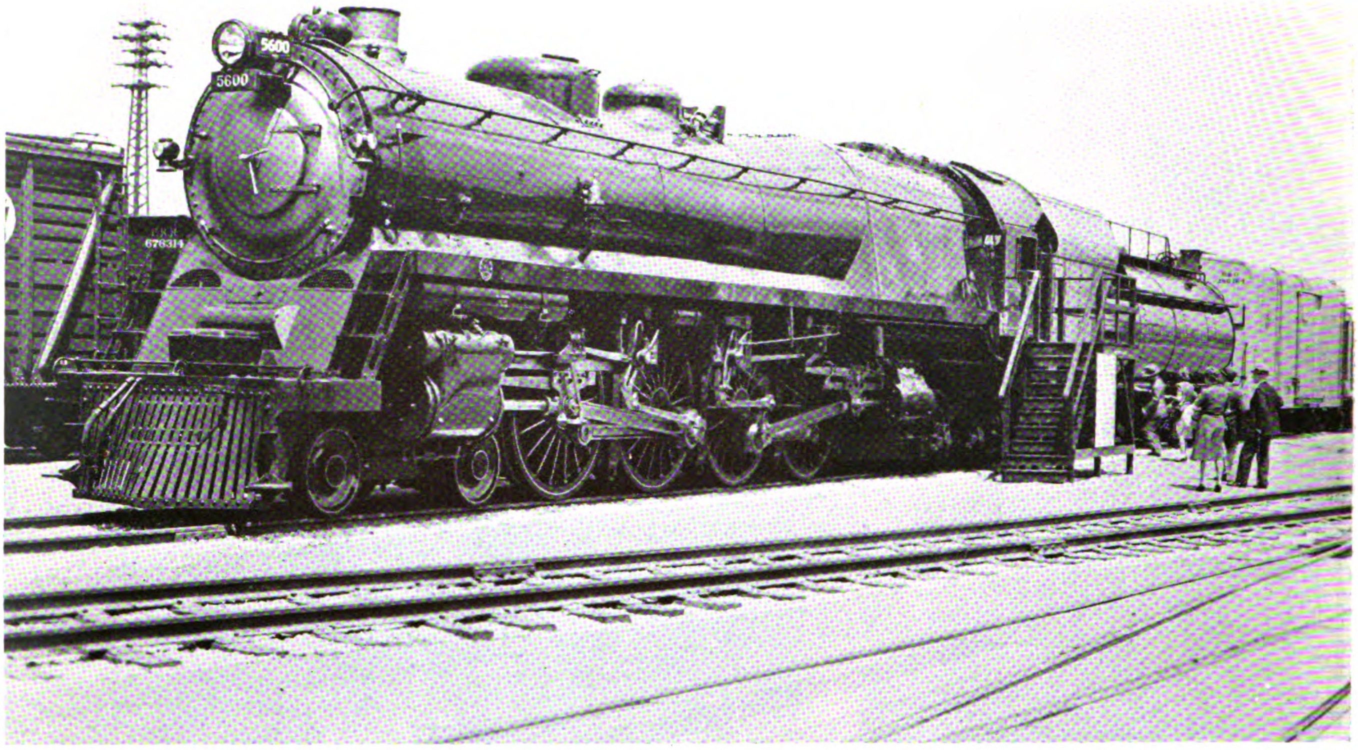




The Foreign Equipment

The passenger equipment of the London, Midland and Scottish train "Coronation Scot" and the Italian State Railways (top picture) seems to be the starting place for track exhibit visitors. The Scot's locomotive and eight cars are an example of Britain's finest passenger equipment. The Italian exhibit is a three- and two-car electric train and gasoline-powered rail car. These are shown in the two pictures at the center of the page. At the bottom, right, is a highway truck designed for handling 31-ton railway cars. This is an Italian State Railways unit

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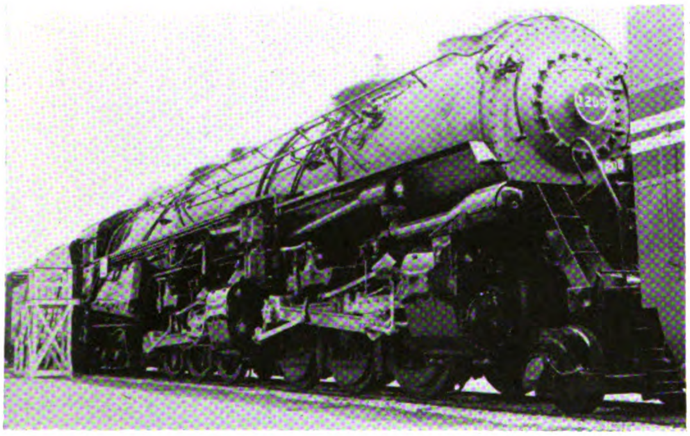
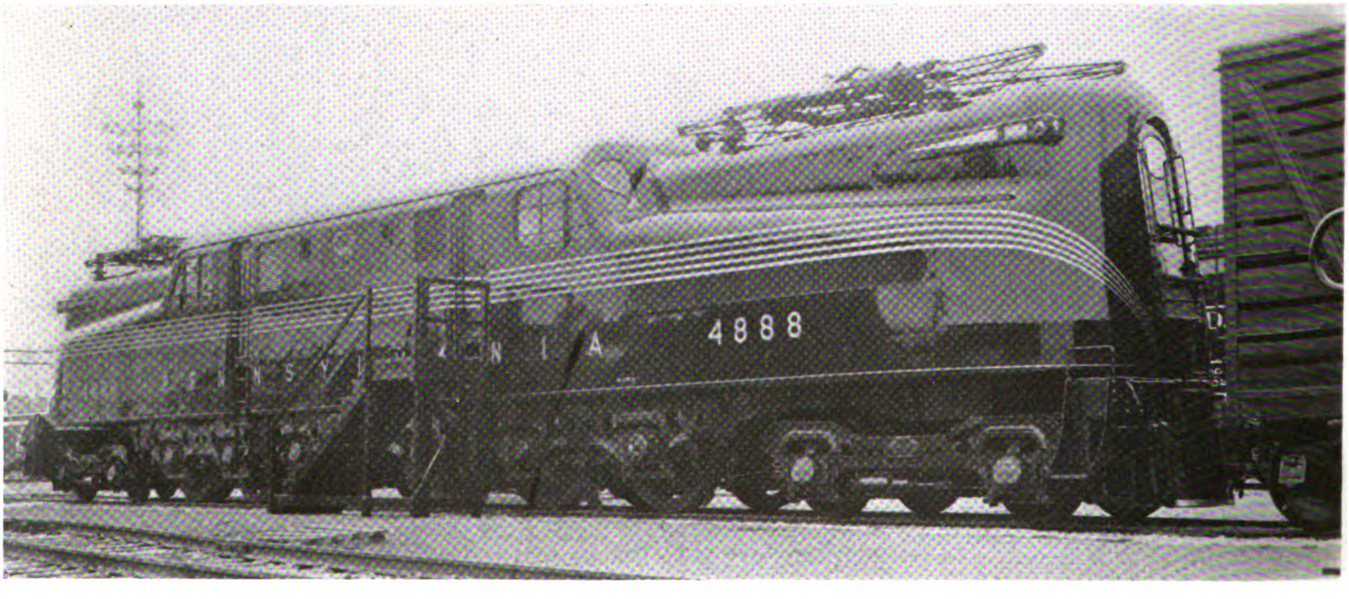



NEW YORK CENTRAL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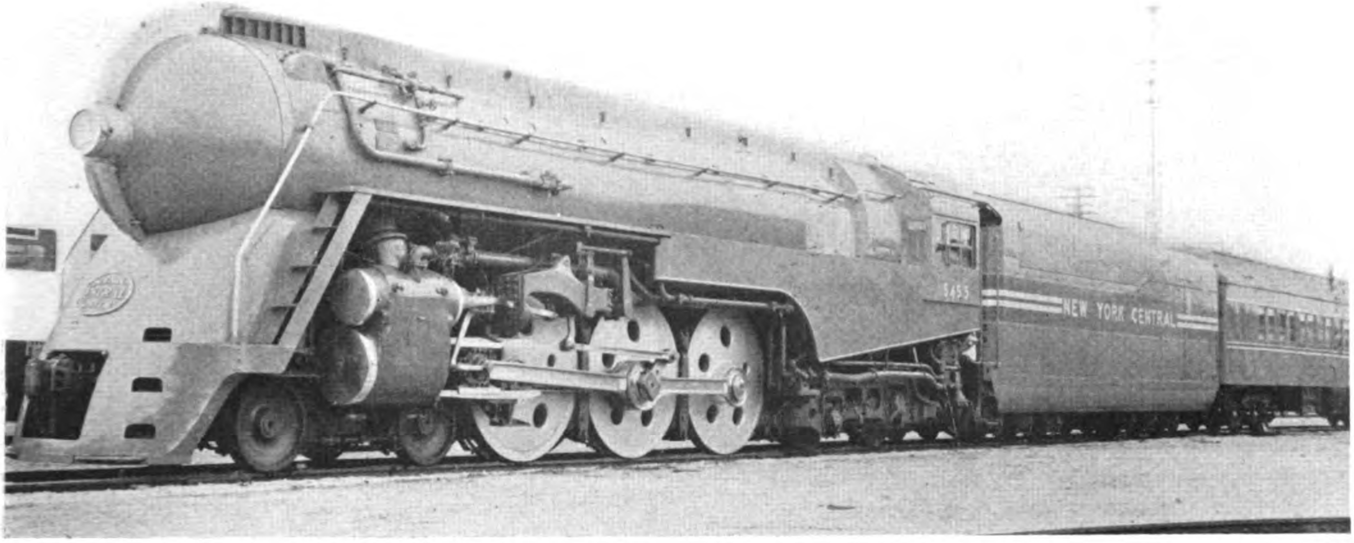
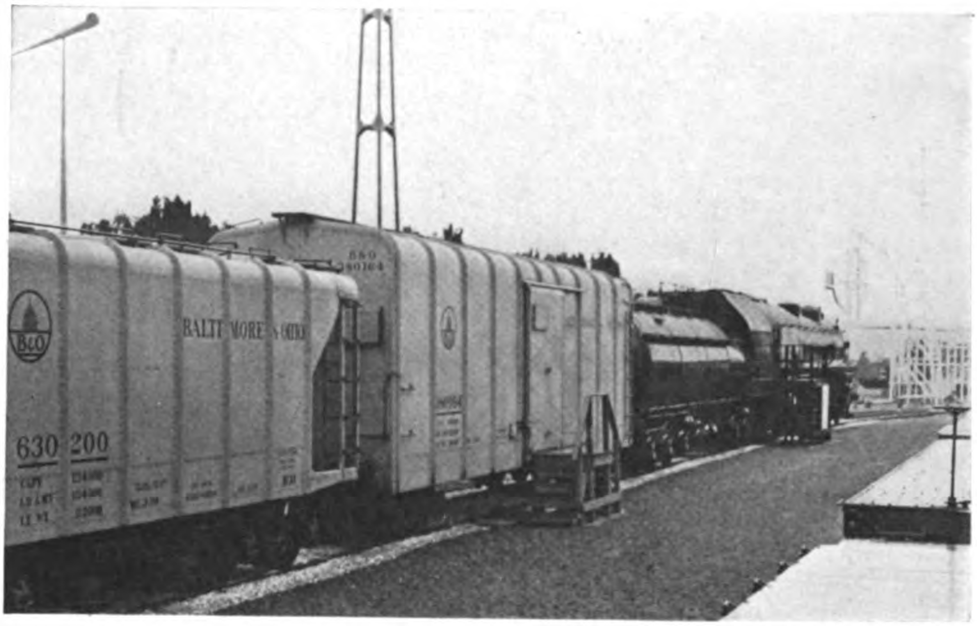
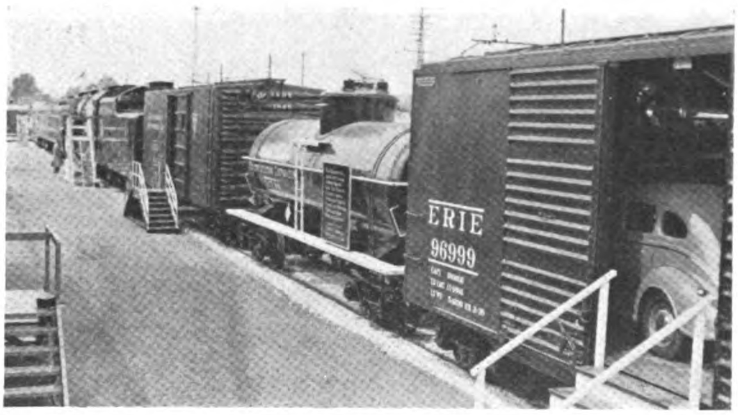


On these two pages appear some of the locomotives included in the track exhibit area. At the top of page 228 is the Baltimore & Ohio's 4-4-4-4 type passenger locomotive "George H. Emerson". This locomotive was exhibited at the 1937 convention at Atlantic City. At the left center of the page is the Norfolk & Western 2-6-6-4 articulated passenger and freight locomotive which has developed over 6,300 drawbar horsepower. At the right center is one of the Pennsylvania's 4-8-2 type steam locomotives and, at the bottom of the page, its electric companion, the type GG-1 passenger locomotive

On this page are two examples of modern railway passenger motive power. At the top of the page is the New York Central streamlined Hudson-type locomotive built in 1938 for service on trains such as the Twentieth Century Limited. These locomotives develop a tractive force of 55,540 lb. and a maximum drawbar horsepower of 3,380 at 65 m. p. h. At the bottom of the page is the Electro-Motive 4,000-hp. Diesel-electric passenger locomotive which is one of the features of the General Motors exhibit near the railroad building. The rear unit of this locomotive is glass-enclosed for public inspection



Above—Two of the units on the Baltimore & Ohio track are the covered-wagon box car and a covered cement car. Left—In the forground is a Pennsylvania well car having a capacity of 250,000 lb. In the background, a Nickel Plate box car and Chesapeake & Ohio hopper car



Above—In the foreground is an Erie automobile car with auto loading racks, and beyond, two General American exhibits, a 10,000-gallon tank car and an all-welded light-weight box car. Right—An all-steel, insulated caboose with cushion underframe, placed among the exhibits by the Lehigh Valley

EDITORIALS

Railroads at the New York World's Fair

In a number of pages in this issue we have attempted to give our readers some impression of the character of the railway transportation exhibits at the New York World's Fair. For those who will attend the annual meeting of the Mechanical Division, Association of American Railroads, which will be held at New York during the last week of June, these pages will serve as a brief catalog of the material available for their inspection. For those who do not expect to see the exhibit, we hope that our presentation may be of interest not only for the items of railway motive power and rolling stock which it presents, but also for something of the atmosphere of the fair which has influenced not only the character of the exhibit, but also the way in which it has been presented.

The theme of the fair is the World of Tomorrow. The railroad exhibit, unlike some of the exhibits, presents the best in the way of railway transportation in the world of today which, in the final analysis, is all that we can be sure of in the world of tomorrow, and presents it against a background of the yesterdays of which it is the direct descendant. Whether or not this method of presentation is leading the public who see it to better understandings or interpretations of modern railway transportation, it is certainly attracting wide interest and attention among thousands of visitors daily.

The railway exhibit is but one of the forms of transportation which are included in the transportation area at the fair. For the railway officer who has sufficient interest in learning what the public wants and how the public feels in matters of transportation to become a student of popular psychology for half a day, a careful observation of the public interest in the various exhibits and the expressions concerning them made by World's Fair visitors may well be of as great value as a study of the exhibits themselves.

The Boiler-Patch Competition Closes

In our March issue we announced a competition for concise articles describing the most interesting problems of patching locomotive boiler sheets within the experience of the contestants. The articles were to deal with either interesting methods of applying patches or with interesting problems of patch design, or both.

On May 15, when the competition closed, twenty-eight entries had been received—gratifying evidence that the subject is of interest to our readers. These are now being studied for the selection of the prize winners. We will announce the names of the winners in the August issue and will also publish the first prize-winning entry at that time.

Deflection Under Load

An engineer is commonly considered to be a man who knows how to utilize materials and natural forces with maximum efficiency in the service of man, and, in this connection, it may be said that no one has surpassed the railway engineer in achieving the highest objectives of his profession. Constant problems arise in the use of new materials which involve not only an accurate knowledge of the physical characteristics of these materials but the exercise of good judgment backed by extensive practical experience in applying this knowledge. Probably the principal difficulty is to determine what are the real facts in any specific problem under consideration and see how these facts check with certain time-tested fundamentals which form the basis of all satisfactory design.

For example, in spite of the extensive use of alloy steels in railway service for many years, one steel manufacturer reports that occasional questions indicate some misunderstanding of the relation between such common characteristics as stiffness and strength; also some uncertainty regarding the relative action of various steels when deflected under load. To throw light on these questions and demonstrate how different steels perform under actual test conditions, three ½-in. square steel test bars, made of annealed low-carbon steel, heat-treated high-carbon steel and heat-treated alloy steel, respectively, were separately placed between knife-edge supports 10 in. apart on a test machine and subjected to variable loads, or pressures, applied at the center. The curves of load in pounds, plotted against deflection in inches, were identical for all three test bars up to about 500 lb. when the soft carbon steel started to take a permanent set. At approximately 1,600 lb., permanent deformation began in the high-carbon-steel bar, whereas this point was not reached in the alloy-steel bar until a load of slightly over 2,200 lb. was applied.

The well established but sometimes misunderstood relationship between stiffness and strength, as again demonstrated by this test, cannot be better discussed than in the following statement by the steel maker referred to: "Within the elastic limit, only the modulus of elas-

ticity of a material has any effect on stiffness (resistance to deflection) of a beam or bar. Other factors, not properties of a material itself, are cross-sectional area and shape, load, and length of span.

"For all practical purposes, the modulus of elasticity is the same for all grades of steel, regardless of alloy content, processing or heat-treatment. This modulus is approximately 1½ to 2 times that of copper and about 3 times that of aluminum.

"Where deflection is the only limiting factor, there is obviously no advantage in using a high-strength steel. Increasing size, changing shape, or shortening the span are the only ways of increasing stiffness of a steel part. Where the limiting factor is not deflection but resistance to permanent deformation, however, the story is different. In the test described, deflection was the same for three steels up to more than 400 lb. of load. But soft steel took a permanent set at approximately 500 lb., while high-carbon steel withstood about 1,600 lb. without permanent set and alloy spring steel withstood 2,200 lb.

"While high-strength steels have no advantage in stiffness, they do provide other benefits, such as greater resistance to permanent deformation (because of their higher elastic limit), higher fatigue strength, greater impact strength, etc."

Thoughtful consideration of the facts just stated indicates that a certain amount of resilience and limited deflection under load undoubtedly should be built into railway passenger cars, for example, in the interests of maximum passenger safety and economical construction. The new A. A. R. specifications call for a design which will resist a certain minimum static end load without permanent deformation and say: "In meeting this requirement, it is important that vertical deflection be kept to a minimum." Many capable engineers of car design feel that this statement, especially if considered without the qualifying footnote, is unfortunate. If it is a fact that vertical deflection should be kept to a minimum, the reasonable inference is that no deflection at all would be a desirable goal. This would mean heavy, cumbersome and uneconomic "battleship" construction, requiring so much metal that there would be little room for pay load and, from the point of view of safety, the hazard to passengers in case of a collision or derailment would be actually increased.

Annual Meeting of the Mechanical Division

Not since 1905, when the Master Car Builders' Association and the American Railway Master Mechanics' Association held their conventions at Manhattan Beach, N. Y., has an annual meeting of mechanical-department officers of the steam railways been held at New York, until this year. On June 28, 29, and 30, the Mechanical Division will hold its seventeenth annual meeting at the Hotel Commodore, the full program of which appears elsewhere in this issue. This is the first time since the beginning of the depression that a three-day annual meeting has been held without the exhibit of the Railway Supply Manufacturers' Association. Two-day meetings were held at Chicago in 1931, 1932, 1935 and 1936. No meetings were held in 1933, 1934 and 1938. During these years the work of the association was kept under way by the action of the General Committee of the Mechanical Division in passing on the reports of important standing committees and submitting the recommendations of these committees for the action of the member roads by letter ballot.

That the Mechanical Division is this year holding a three-session meeting with one session on each of three days is indicative of the value which the General Committee places on the New York World's Fair as a substitute for a strictly technical exhibit of cars, locomotives, car and locomotive devices and materials, and shop equipment.

Locomotive Horsepower And Train Weight

It is not often that a clear-cut opportunity presents itself for the comparison of railway motive power and rolling stock of two countries with as wide variance in methods of design as are found in England and America. An interesting opportunity of this kind is presented, however, by the A. A. R. tests of a 1,005-ton passenger train which were run last fall and the test runs with a 676-ton train of passenger coaches on the London, Midland & Scottish during February of the present year. The tests, themselves, are not of a comparable character, since those conducted by the A. A. R. were for the specific purpose of determining the horsepower capacity required in a locomotive to handle a 1,000-ton passenger train at 100 m. p. h. on level tangent track, while those of the L. M. S. were to check the performance of a specific class of locomotives with a train considerably heavier than the normal weight of the service the locomotive is designed to handle. The interest lies in the comparison of train weights and horsepower capacity in the two cases, and the comparison of passenger accommodations which were available in the two trains.

It will be recalled that the A. A. R. test train consisted of 14 Pennsylvania P70 class coaches, a baggage car, and a dynamometer car. This train had a weight of 1,005 tons behind the tender and measured 1,226 ft. 11$\frac{3}{16}$ in. long behind the tender. As to passenger accommodations, the P70 coaches are in service with several arrangements of facilities. The greatest seating capacity of any arrangement of these cars, however, is 88. Using that as a basis for comparison, the A. A. R. train provided seats for 1,232 passengers in addition to a 63-ft. baggage car.

The British trains consisted of 19 passenger coaches, some of the corridor and some of the aisle type, and a

dynamometer car. The coaches, most of which were 60 ft. 8 in., varied somewhat, the longest ones being 63 ft. 8 in., both coupled lengths. This train weighed 676 tons behind the tender, was 1,212 ft. 11¼ in. in length behind the tender, and contained seats for 1,026 persons. Two combination brake vans provided the approximate equivalent of two-thirds of a car length for luggage space.

Three classes of locomotives were employed in the A. A. R. tests—a Pennsylvania K4s type, a Chicago & North Western E-4 4-6-4 type, and a Union Pacific FEF1 4-8-4 type. The latter, which has the greatest horsepower capacity and develops a tractive force of 63,500 lb., presents the most pertinent comparison with the Duchess type locomotive employed in the L. M. S. tests. This locomotive is of the same dimensions and proportions as the Coronation Scot locomotive now on exhibit at the New York World's Fair. It differs principally in that it is one of a group of these locomotives which were built without streamlining and, as a result, has a total engine weight approximately 6,500 lb. less than that of the Coronation Scot streamline locomotive. It has a tractive force rating of 40,000 lb.

The Union Pacific locomotive has developed a maximum indicated horsepower of about 4,900 and weighs 415.75 tons. The combined weight of train and locomotive is 1,420.75 tons, and there is about 3.5 indicated horsepower per ton of combined train and locomotive weight. The Duchess class locomotive on the test runs developed a maximum drawbar horsepower of about 2,500 and a maximum indicated horsepower (calculated) of about 3,350. This locomotive weighs 181 tons and the combined weight of locomotive and train is 857.5 tons. This is an indicated horsepower of 3.9 per ton of combined train and engine weight.

On a fairly comparable basis the American coaches provide seats for 11 per cent more passengers than are accommodated in the British train. The weight of the American train behind the tender is 49 per cent greater than the British train, and the locomotive is 130 per cent heavier than the British locomotive.

The L. M. S. test train, however, was much heavier than the limit of 470.5 tons which now obtains on the Royal Scot service, which is handled by the locomotive tested. With a train of this weight behind the tender the combined engine and train weight is 651.5 tons and there is an indicated horsepower capacity of 5.15 per ton of combined train and locomotive weight. With a locomotive of the capacity of the Union Pacific 4-8-4 type 5 hp. per ton of combined train and engine weight would limit the weight of the train behind the tender to 584 tons and to no more than seven coaches, of the capacity and weight of those employed in the A. A. R. tests, in addition to the dynamometer car and the baggage car.

To provide a ratio of 5 hp. per ton with the 1,000-ton train would require a locomotive capable of developing about 8,000 cylinder horsepower which would weigh about 660 tons, if proportionately the same weight as the Union Pacific locomotive. It is evident that the economically practicable basis for the solution of high speeds in America is reduced train weight as well as increased horsepower capacity.

New Books

TOOL MAKING. *By Charles Bradford Cole, M. E., Published by the American Technical Society, Drexel avenue at Fifty-Ninth street, Chicago. 413 pages, 475 illustrations. 5½ in. by 8 in. Price, $3.50.*

This "how-to-do-it" book leads the apprentice toolmaker from the simple facts about his personal tools and the equipment which the shop provides, to the processes of the toolmaker's craft. This is done through the actual presentation of typical jobs, these jobs being presented as finished working drawings from which the tools they represent may be made. American and National Standard screw threads for bolts, nuts, machine screws, and threaded parts are given in the appendix.

PROTECTIVE COATINGS FOR METALS. *American Chemical Society Monograph Series No. 79. By R. M. Burns, Ph.D., assistant chemical director, Bell Telephone Laboratories, and A. E. Schuh, Ph.D., director of research, United States Pipe and Foundry Company. Published by the Reinhold Publishing Corporation, 330 West Forty-Second street, New York. 385 pages, 5½ in. by 9 in. Price, $6.50.*

About three years ago, upon invitation and with the consent of H. S. Rawdon, author of "Protective Metallic Coatings" which was published in 1927, Messrs. Burns and Schuh undertook to revise Mr. Rawdon's book. During the process, however, it was found expedient to enlarge the scope of the book to include protective coatings of all types, including paint, that those interested in corrosion prevention might be given more comprehensive information on the subject. Hence, the present volume is designed primarily for those who have problems of protection, although considerable information is given on the production of protective coatings so that the reader may have a better understanding of the nature of the various coatings. The sixteen chapters cover Protective Coatings and the Mechanism of Corrosion; Surface Preparation for the Application of Coatings; Types of Metallic Coatings and Methods of Application; Zinc Coating by Hot-Dipping Process; Zinc Coating by Electroplating and Cementation; Protective Value of Zinc Coatings; Cadmium Coatings and Their Protective Value; Tin Coatings; Nickel and Chromium Coatings; Coatings of Copper, Lead, Aluminum and Miscellaneous Metals; Coatings of Noble and Rare Metals; Methods of Testing Metallic Coatings; Composition of Paints and Mechanism of Film Formation; The Durability and Evaluation of Paints; Paint Practices, and Miscellaneous Coatings.

IN THE BACK SHOP AND ENGINEHOUSE

Carbides in a Railroad Shop

*By C. G. Williams**

The writer walked into a railroad shop of one of the largest railroad systems in the country to talk carbides. He was sent to see the assistant shop superintendent who, after listening to our remarks, said "That steel is no good—I have tried it all and it won't stand up, I tell you." At the continued statement that he had never seen that type or grade of carbide-tipped tool, and the suggestion that it be given a trial which would increase production enough to offset any interruptions in shop work, he grumblingly said: "All right, if you want to try it, come on."

He walked down the shop until he came to a 36-in. lathe that was nearly new, on which they were reconditioning piston rods. The lathe was equipped with a special tool holder and a ball-bearing tailstock center, so it was known that there would be a minimum of vibration, for nothing will start up vibration quite as quickly as the old conventional tool post. The machine was powered with a 25-hp. motor, thus assuring no difficulty from lack of speed or power, as the cut at no time would be in excess of 3/32 in. deep. The mechanic operating the lathe was ordered to give every co-operation, so no time was lost in giving him a tool to start the work.

When asked the price of the tool, which had a shank 1 in. by 2 in. by 8 in. and a tip 5/16 in. by 1/2 in., the assistant superintendent was told that in the milled and brazed condition the cost would be $20.26 for a single tool but that in large quantities the price would be lower, at which he yelled "$20.26 for that tool! what do you think we are made of, money?" The reply was, "Keep your shirt on and don't yelp until you are hurt. Just wait until you see what can be done."

The machine was being operated at 58 surface ft. per min., with a depth of cut from 1/32 in. to 3/32 in. and a feed of .024 in. per revolution. When the operator had clamped the tool in the rest, he was requested to set the speed at 214 r.p.m. or 294 s.f.m., at which every one drew a deep breath and the mechanic let his out with a long drawn out "What!" "Just 214 r.p.m." was the reply, and that was what we got, with a depth of cut and feed as used before.

When the first piston was completed and a new one put into the lathe, the operator was asked to set the speed at 296 r.p.m. or 406 s.f.m. By this time we had an audience which apparently expected to see some one get killed, but nothing happened. The depth of cut and feed were held as before.

As there was no accident while turning this piston rod, another one was set up and again the speed was stepped up, this time to 398 r.p.m., which for that piston gave 673 s.f.m. Feed and depth of cut were the same as formerly. Will some one please figure the savings made on this last piston on a surface cut 52 in. in length?

This railroad has several Diesel road locomotives and also Diesel powered switching locomotives. In reconditioning them, the shop men try to follow recommendations laid down by Canadian railroad officers, such as building up the worn journals on the crank shaft by chromium plating†, also in "stepping" the sizes of pistons and cylinders.

In the case of chromium-plated crank shafts, it was found that this process entailed more work than formerly, as the bearing must be reground or remain off center to a greater degree than as worn, also there must be added to the cost of reconditioning, the cost of plating, which in itself was no small item.

At this stage of the game, this carbide demonstrator walked into the shop to be greeted with profanity. Somewhat later a suggestion was made "Why not build up the pistons with aluminum allow spray and the crank-shaft bearings with sprayed 1.25 carbon-steel wire." "It has been tried elsewhere and is no good. It can't be machined, and grinding takes too long," was the reply. Oh yes, it has been tried and successfully machined with carbide-tipped tools at 185 s.f.m., roughing cut .080 in. deep and .018 in. per revolution feed. For finishing, the same speed (the limit of the belt-driven lathe), .002 in. depth of cut and .018 in. per revolution feed are used, no grinding being required and making a very fine lasting and hard-surfaced bearing, with a Brinell hardness of 550.

"But we will need to purchase a spray gun, a gas furnace for brazing on the carbide tips, a grinder and a lot of special grinding wheels," comes the objection. What of it? This equipment will prove a good-paying investment, badly needed to bring railroad maintenance practice up-to-date, as compared with that of increasingly active competitors in the field of modern transportation.

* Consulting Engineer.

Heating Work In the Boiler Shop‡

As a readily portable source of intense heat, which is easily controlled and easily localized, the heavy-duty heating blowpipe is admirably adapted for the forming and fitting of locomotive boiler plates. In one locomotive boiler shop, where the oxyacetylene flame has replaced former heating methods, completion of several operations, which previously required hours of labor, is now simply a matter of minutes.

The straightening of pressed flanges on firebox back heads is one of these operations. These back heads are first shaped on a heavy press to provide a flange for the riveted lap joints between the back head and wrapper sheets. This flanging operation leaves an irregular edge which is heated by means of the blowpipe without danger of warpage and then straightened with a hammer and flattener. The flanged fire door opening in the center of the sheet is also included in this preliminary straightening operation.

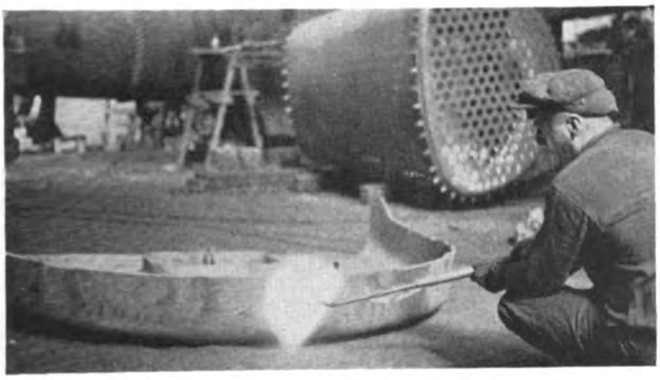
The back head is then placed on a steel straightening block for finishing. Additional local heating and flattening with a sledge hammer and a flattener produce a

† See *Railway Mechanical Engineer*, November 1937, Methods Used on the Canadian National for Maintenance of Diesel Engines, page 509.

‡ Reprinted from the May, 1939, Oxy-Acetylene Tips.

long, thin taper on the flange. This assures a straight and smooth edge where the back head is to be joined to the rest of the outside firebox sheets. Side sheets are similarly tapered.

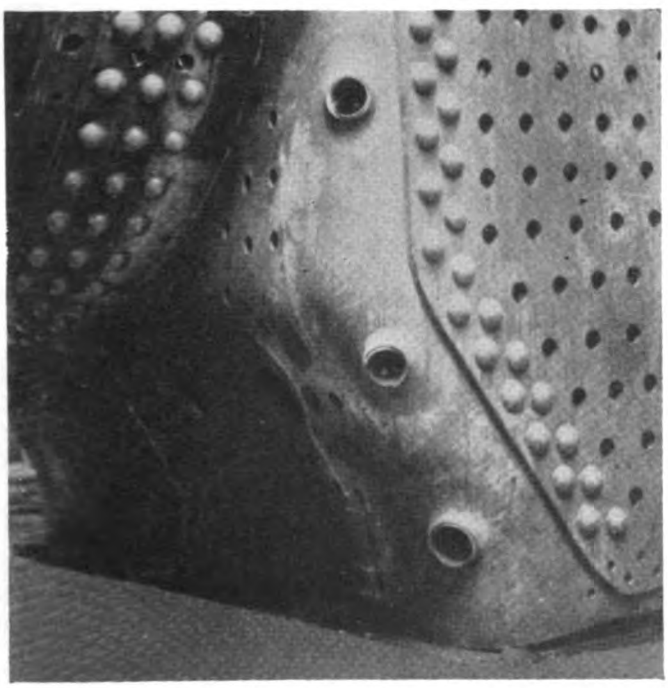
By means of the blowpipe, heat is applied to the joints of the boiler and firebox sheets which are fitted and



Heating the flange of a locomotive firebox back head during preliminary straightening

bolted together prior to riveting. When the plates are properly heated, they are hammered into close contact and the bolts are drawn tight until a snug fit is assured. Minor straightening is accomplished with a dolly and a hammer.

The use of the blowpipe makes it possible to apply heat, during the fitting operation, to either the throat sheet, the back head or the wrapper sheet without heating the rest of the assembly. Because the highly concentrated heat of the oxyacetylene flame is thus confined to a small area and applied only where it is needed, possible plate distortion requires little consideration.



Flanged nipples formed with a tapered punch and hammer after heating

The oxyacetylene flame is also used in forming flanged nipples in the boiler plate. The three nipples illustrated are located in the throat sheet between the boiler and the firebox. Each was formed by heating the metal around the hole with the blowpipe flame and driving the hot metal to the outside of the sheet with a tapered punch and hammer.

The production of such consistently well-formed nipples has been possible only since the oxyacetylene was introduced as a heat source for this operation. In using previous forms of heating, it was almost impossible to localize the heat sufficiently to assure equally good results.

During the performance of work of this type inside the boiler or in other confined spaces, there should be adequate forced ventilation, or the operator should be equipped with a mask that is supplied with air from an outside source.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Methods of Determining Satisfactory Welds

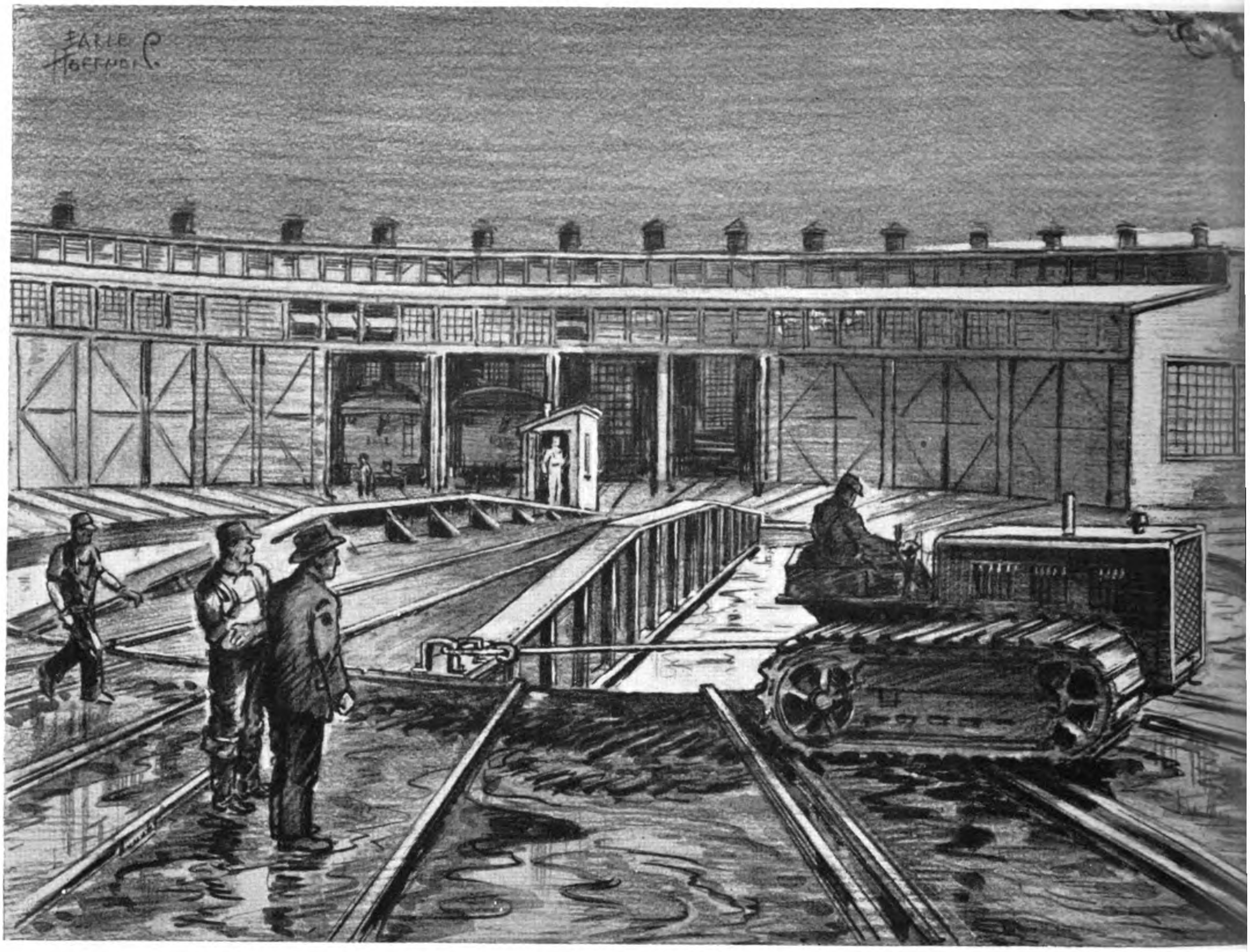
Q.—What methods can be employed to determine whether or not a weld is satisfactory, assuming the test specimens meet all requirements?—F. R. D.

A.—There are four recognized methods of inspecting the quality of welds.

Inspection with Stethoscope—The stethoscope is used mostly as an inspection preliminary to making X-ray examinations of doubtful regions. By listening with the stethoscope while tapping gently along a welded seam with a light hammer, an experienced person is able to detect the difference in sound when the hammer strikes the weld in the immediate vicinity of a fault. Its effective use requires a high order of perception of sound quality, together with considerable skill and training.

Electro-Magnetic Method of Inspection—The magnetic reluctance of a weld of ferro-magnetic material is increased by any fault occurring in it. Hence, when a magnetic flux is passed through the weld and adjacent base metal, with the lines of a flux approximately at right angles to the weld, there will be more flux leakage directly over the faults than at good portions of the weld. The faults can be detected either by sifting iron filings or iron powder on a piece of paper placed on the weld and observing the picture formed, or by exploring with an instrument capable of reading the strength of the leakage flux. This method is quite sensitive to cracks or poor fusion at or only a short distance under the surface of the weld, particularly if the weld be smooth and flat and in a flat position. The sensitivity is considerably impaired by the rough surface of the weld, by sloping or vertical surfaces, or by the fault being buried far beneath the surface.

(Continued on page 239)



Wolf! Wolf!

THE boy in the second reader cried "wolf" once too often and lost his sheep. H. R. Long, general foreman for the S. P. & W. at Plainville, did the same thing and came very near tying up the whole railroad.

When the company physician told John L. Starkey that he could take ninety days off and perhaps live to enjoy a pension, or stay on the job and let his widow collect his insurance, Starkey decided in favor of prospects of a pension.

When H. H. Carter, the master mechanic, suggested to Jim Evans, the roundhouse foreman, that he take over in Starkey's place, Evans vetoed the idea. "My job will drive a person nuts," Evans said, "and that one will worry you to death. I prefer to be a living lunatic." Evans laughed to show that he was joking, but he didn't take the job.

One of the backshops where Long was foreman was temporarily closed down. He was sent to Plainville to fill the vacancy while Starkey was recuperating.

"I've heard this is a pretty hot job," Long told Evans, "but I don't see why it should be."

"Oh, it's not so bad," Evans said. "The worst trouble is the roundhouse is too small and we are way out here on the tail end of the railroad where it takes quite a while to get material."

"Well, I'll leave it with you for the rest of the afternoon," Long said. "See you in the morning."

The new general foreman was on the job bright and early next morning. He and Evans both arrived at about the same time. Evans went into the back office to change clothes. Long stopped to look at the dope book and some work reports that were laying on the desk in the front office.

"The engineer reported the driving-boxes pounding bad on the 5082," Long said. "Maybe we had better run her over the drop-pit and drop the drivers."

"Good idea," Evans agreed, "if you've got enough engines without her."

"The 5071 is reported not steaming," Long read from another report.

"And," Evans added, "the engine rides hard. Stewart came in on her, didn't he?"

"Yes; how did you know?"

"That's easy—no engine ever steams good for Stewart

The tractor, fortunately for the foreman's blood pressure, was available. An hour later it was slithering over wet rails and slippery mud around the turntable pit pulling the table

by
Walt Wyre

• • •

and they all ride hard." Evans pulled on a jumper and reached for his battered old derby. "I'm going to the roundhouse and get the work reports lined up."

"O. K.," Long said. "I'll be with you shortly."

THE new general foreman didn't say much the first day, but it was very evident he wanted to. Several times he acted nervous as a country cat in town. One time when an engine was called for 11:30 and was still in the house at 10:45, he chewed off all the finger-nails on his left hand and was just starting on his right when the hostler came after the engine at 10:55.

Next morning Long decided to speed things up a little. He started in at the drop-pit.

The 5085 was scheduled to be out in a couple of days and unless something unusual happened, it would be. Machinist Cox was grooving the crown brasses and the drivers would be ready that day.

"How soon will you be ready to start putting the drivers up?" Long asked the machinist.

"Oh, sometime tomorrow," Cox replied.

"We've got to get her sooner than that," the general foreman said. I'm figuring on running her tomorrow night. Rush the work up," he added.

Cox, willing to accommodate, pitched in. By extra effort and letting a few little things go, he was ready to start up with the drivers before five o'clock that day.

Next morning about ten o'clock, Long told the fire-builder to get the 5085 hot. He marked the engine up on the board to run that night.

"What are you trying to do?" Cox's helper complained. "Use up all the work there is in one day?"

"The general foreman said he had to have the engine today," Cox replied, "and it's up to us to get it."

At 4:30 the 5085 was finished. The hostler ran it off the drop-pit and into another stall. Next morning the engine was still standing there and it stood all day.

"Guess old hurry-and-rush didn't need the 5085 bad as he made out," Cox's helper commented.

"Guess you're right," the machinist agreed. "But maybe something happened and he didn't have to have the engine."

The nickname "Hurry-and-Rush" stuck and the general foreman lived up to it. Every job was an emergency and every engine was needed immediately if not sooner.

The 5088 valves were reported blowing. Machinist Martin and his helper were given the job of pulling the valves.

They had just started when the general foreman came by. "Get it soon as you can," Long told the machinist. "I've got to run her west at 1:30. I want to look at the bull rings when you get them out," he added.

"O. K.," Martin said. "We'll have them out in a little while."

When the general foreman inspected the valves, it was found that new packing rings would suffice for the present. New bushings and bull rings would be needed sometime soon, however.

"All right," Long said, "I'll give you a requisition for rings. Get them in soon as you can." The general foreman gave him the requisition and went to the storeroom.

"How many valve bushings and bull rings for 5000s have you got on hand?" Long asked the storekeeper.

"Two of each," the storekeeper replied.

"That's not enough;" the foreman shook his head, "order two sets of each—better wire for them and have them shipped passenger."

The 5088 didn't run until sometime that night. Machinist Martin was sore as boil ready to burst because he had worked at top speed to get the engine finished and then it didn't run.

BY the time the general foreman had been on the job two weeks, nobody paid any attention to his urging. If it made any difference, there was a tendency for the work to slow down.

In the meantime, Evans was having trouble of his own and the general foreman interfering in the roundhouse didn't help any. Once or twice Evans had tried to talk to the general foreman about how conditions were getting, but Long didn't seem to realize what the trouble was

and changed the subject. The general foreman blamed the men; said they were laying down on him.

"The men are all right," Evans told him. "They are about as good as you'll find any place."

"But it doesn't seem like they are getting the work out like they should," Long said. "I don't like the idea of waiting until the last minute to get an engine ready."

"Neither do I," Evans said, "but we can't help it. That's a running repair job for you. I'd like to have at least one extra engine ready to go at all times, but it can't be done."

"Why can't it?" Long asked.

"Well, in the first place," Evans told him, "if we had an extra engine, the officials would make us store it. In the second place, we're not going to get it. We're getting along fairly well—only had one engine failure since you came."

"Maybe so," Long admitted, "but I've nearly had heart failure a dozen times a day."

"That's part of the job too," Evans told him, "if you let it affect you that way. Have you noticed the tires on the 5083?"

"No, I'll go look at them." The general foreman walked out to the inspection pit where the 5083 was standing. The tires were getting in bad shape. The one on the right main driver in particular had a sharp flange and all were tread worn. The tires were too thin to stand another turning, too.

Long hurried out where the tires were stacked to see if there were some that could be used. There weren't.

He rushed to the storeroom. "Say, how about a set of tires for the 5083?" he asked the storekeeper. "I need them right away."

"Will this afternoon be soon enough?"

"Rush them up," Long said. "The ones on her are not in condition to make a trip."

"O. K.," the storekeeper agreed without enthusiasm. "And say, what about those bull rings and valve bushings I had shipped passenger? They're still here."

"We'll need them," Long said. "In fact, they're needed right now if I could get time to use them."

The storekeeper made a memorandum to order the set of tires and promptly forgot about it, for the time being, at least. Two days later he sent the requisition off, but without notation to rush them.

LONG had been in Plainville four weeks when things seemed suddenly to go all to hell. It started Monday morning with a rain that would have started Noah to loading animals. Heavy rains are not usual in Plainville. As a result no one is ever prepared when one comes.

The roundhouse roof leaked worse than army pup tents during the World War. By eight o'clock the roundhouse office looked like a houseboat standing in a lake. Between each pair of rails going to the turntable a small river flowed, the water cascading into the turntable pit. No one noticed that the drain was stopped until the water was over the circular rail and rapidly rising. By the time the water service men were located, the water had risen six inches more.

The big gears on the turntable tractors were dipping water when Ned Sparks, the electrician, noticed them. He watched while the table was being turned. At high speed the gear teeth carried the water up and sprayed a large portion on the motors.

"Say," Sparks yelled to the hostler helper who was operating the table, "slow down! You're going to drown them motors!"

The hostler helper, if he heard, didn't heed. The table continued to turn as fast as the motors would turn it. The electrician rushed over to the cab. By the time he got there, the hostler helper was lining the table.

"If you run the table full speed, water splashes over the motors," Ned told the hostler helper. "Run it slow as you can or you'll burn the motor out."

"O. K.," the helper agreed as he waved a watery signal to the hostler.

The water service men waded in waist deep and probed at the drain in the turntable pit trying to open it up. Results, if any, were only to wedge tighter whatever obstruction clogged the drain, and the water continued to rise.

At 9:30 the turntable gears were half submerged and running the table slow didn't prevent water being thrown on the motors. The rain had eased up a little, though, and light streaks in the clouds indicated that it would quit altogether soon.

The electrician told the hostler that running the turntable might cause the motors to be ruined.

All engines that were to run soon were out of the house, but three were standing ready to go in. The hostler was waiting for the water to subside somewhat in the turntable pit before putting the engines in the house when the general foreman came out.

"Why don't you get them engines in the house?" Long asked the hostler.

"The electrician said it might ruin the motors . . . "

"We've got to get them engines in the house," the foreman interrupted. "Have your helper line up the table."

"O. K." The hostler went in search of his helper.

The electrician, hearing the turntable running, rushed out to see what was going on.

The hostler helper mindful of what Sparks had told him was running the motors at slow speed. The general foreman was imitating a chicken crossing a road covered with hot asphalt. He stood it long as he could. "Is that as fast as it will run?" Long yelled.

"No, but the electrician—"

"Blast the electrician! Hurry up and get them engines in the house. Let me have it!"

The foreman fairly grabbed the controller handle. Br-r-r--r!-- the roller sang over the notches as he shoved the handle all the way round.

The traction wheels spun on the wet rail. The gears became whirling fountains and the motors became wet.

Some motors will run submerged in water, but they are designed for that purpose. The ones on the turntable at Plainville are not that type. The motor on the cab end went out first. The electrician was standing by the side of the pit waiting for it to go when it happened. There was a flash of fire under the cab. An instant later the overload relay kicked out. Long stopped the turntable.

"What happened?" he asked.

"Motor grounded," Sparks told him. "It got wet."

"One motor will turn the table, won't it?"

"Yes, but I'm afraid it's wet too."

"We've got to get these engines in the house." The foreman shoved the controller handle around.

The one motor groaned a protest and started, pulling the table alone. He got the first engine in the house, but the other motor quit before the table was spotted for the second.

"How soon can you get it going again?" Long asked the electrician.

"I've got one extra motor," Sparks said. "We might be able to get it going tonight or maybe with good luck late this evening."

"We've got to get the engines out," Long said earnestly. "How we going to do it?"

"The maintenance of way has a big caterpillar we used one time," Sparks told him. "I don't know whether it's in town or not. The division engineer would know."

The tractor, fortunately for the foreman's blood pressure, was available. An hour later it was slithering over wet rails and slippery mud around the turntable pit pulling the table. It was a slow process, but the tractor made it.

By one o'clock the rain had stopped and the sun was shining brightly, but trouble didn't leave with the clouds.

Two delays getting engines out could be charged to the turntable, but a broken main pin couldn't. The 5077 was nine miles out when it happened. The engineer was on short time to beat the Limited into Plainville when the pin let go. Sixty miles an hour may not be so fast nowadays, but the back end of a main rod turned loose at that speed will do a lot of damage.

The 5068 was sent out to bring the train and crippled engine in.

About two o'clock that afternoon the dispatcher called and said he wanted an engine about midnight for an extra east. "It's a Chamber of Commerce Special," the dispatcher said, "and mighty important. The general manager is on the train," he added.

"What are we going to use?" Long asked Evans.

"The 5083 should come in on 71 about four o'clock," Evans said. We might use her.

About two-thirty a message was received from the foreman at Sanford, the next division point east: "The federal inspector examined tires on engine 5083 date. Suggest they be renewed before engine is dispatched again."

Long read the message and headed for the storeroom like a belated whirlwind. "How about the tires for the 5083? Have you got them yet," he asked excitedly.

"Next week," the storekeeper replied placidly. "You haven't used all them bull rings yet."

"But I've got to have them." The general foreman laid the message on the storekeeper's desk.

"Let's see;"—the storekeeper picked up a stack of bills—"they should be in about day after tomorrow."

Long sputtered and fizzed like soda in lemon juice, but that didn't get the tires. "I told you I was in a rush for those tires," he said.

"Yes, and you told me you were in a rush for those bull rings and valve bushings, and everything else I've ordered in the past six weeks," the storekeeper reminded him.

That was that and nothing to do about it. The general foreman left the storeroom and went back to the roundhouse office. "Now what are we going to do?" he asked Evans.

"I'll guess with you," Evans said soberly. "It looks pretty bad. We might get enough men on the 5084 and get her off the drop-pit."

"It's a slim chance," Long said, "but our only one."

Chances of getting the 5084 finished were slimmer than the foreman had feared. Cox hadn't even started putting the wheels up.

"We've got to get this engine finished and out by ten o'clock tonight," the general foreman told the machinist. "I'll give you some help on it," he added.

"O. K.," Cox agreed, "we'll do our best."

"Another rush job on an engine to stand around two or three days after it's finished!" Cox's helper said when the foreman had left.

"Don't worry," Cox said. "I've quit rushing."

Two other machinists and their helpers were sent down to the drop-pit to help on the 5084. The general foreman told them as he had told Cox that the engine had to be out by ten o'clock. They didn't believe it either.

At five o'clock it was very evident that the 5084 would not be finished. All of the men were working but without hurrying. If any difference, they were working more slowly than usual.

Long raved and stormed, but it had no effect on the men except possibly to cause them to slow up a little more.

"What can we do?" Long asked Evans for perhaps the hundredth time.

Evans scratched his head thoughtfully. "Will you do what I say if I make a suggestion?"

"I'll do anything if there's any chance of getting the 5084 finished."

"All right! Don't come around the drop-pit until 10:00 tonight. Yes—you might come around about 7:30 with a lot of sandwiches and a pot of coffee; and don't say a word to any one when you do."

"I don't understand," Long said.

"Well, I'll tell you." Evans bit off a hunk of "horseshoe". "You've hollered wolf so often the men don't believe you when one really shows up. I don't know whether we can get the 5084 finished or not, but we'll try."

"I hope it works," Long said.

Evans went to the drop-pit right after the five o'clock whistle blew. The machinists were standing around not knowing exactly whether to work or not.

"Fellows," Evans began, "we're in a hole. We've got to have this engine out tonight. And when we finish it's got to run. Can we do it?"

No one answered.

"If we can, pitch in;" Evans went on, "if we can't there's no use working overtime on it." He turned and walked away satisfied by the look on the men's faces that every effort would be made.

Evans was right. At 10:15 the 5084 rolled across the turntable. If the consumption of valve oil jumped that month, it was because every bearing on the 5084 was dripping with it; but she ran. And the general foreman learned it's a good idea not to shout "wolf" until the animal appears.

Locomotive Boiler Questions and Answers

(*Contnued from page 235*)

Inspection by X-Ray—Weld metals can be X-rayed and their internal defects clearly visible on photographic plates. If there are cracks, holes or general porosity within a weld, the X-ray photograph will reveal the condition. The method is simple. It consists of placing an X-Ray tube on one side of the weld and the photographic plate on the other. After proper exposure, depending upon the thickness of the material and the strength of X-Ray, the plate is developed and examined for defects in the weld. This method is widely used as final inspection of pressure vessels which come under Class I of the A. S. M. E. Boiler Code.

The Gamma Ray Method—Newer than but similar to X-Ray inspection is inspection by Gamma Rays. The Gamma Ray emanates from radium. This ray penetrates the weld more quickly than the X-Ray and is therefore used either for inspecting heavy work, which would require impracticably long X-Ray exposures, or for speeding up inspection on ordinary material.

Welding the Ends of Longitudinal Butt Straps

Q.—On page 157 of the April, 1938, issue of the *Railway Mechanical Engineer* you answered a question on the welding of the outside welt strap. In this particular joint there are five rows of rivets. Would the same welding be applied to a joint in which there are only three rows of rivets? Our instructions are that any welding on the boiler barrel be protected by riveting. Do you consider this to be necessary, and if so, would the inside welt strap on the joint shown in the April issue be taken as protecting the weld?—E. L. B.

A.—The seal welding of the shell and the outside butt strap for tightness would apply to a triple-riveted seam in the same manner as to a quadruple riveted seam.

In the case of the seam submitted with the question, as illustrated in Fig. 1, it would only be necessary to weld along the shell course for 12 in. as shown, the outside butt strap at this end of the seam being on top of the circumferential seam and can, therefore, be readily caulked; the 12-in. weld along the shell course seals the end of the seam.

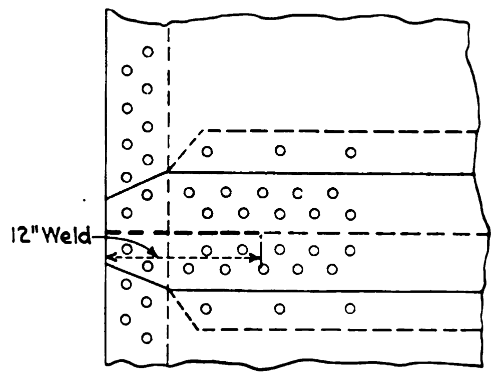


Fig. 1

The illustration shown in the April issue shows the opposite end of the seam where the outside butt strap and the circumferential seam are in the same plane, making it difficult to caulk the edge of the outside butt strap adjacent to the shell course and for this reason, seal welding is used in place of caulking around the end of the outside butt strap in addition to the 12 in. along the shell course.

In all cases where the strength of the structure is dependent upon the strength of the weld, the weld should be reinforced so that the safety of the boiler is not dependent upon the strength of the weld.

The welding of the ends of longitudinal seams as illustrated in Fig. 1 does not in any way affect the strength of the structure in that the strength of the seam or its efficiency is not dependent upon the strength of the weld which is used only to seal the end of the seam.

Layout Work for Apprentices

Q.—Where can a textbook be obtained that deals with the laying out of the parts that make up a locomotive boiler. We have 14 boilermaker apprentices and some of the older boys have taken the usual work in developing surfaces. Since some of them are nearing the completion of apprenticeship, I would like to give them some locomotive boiler layout work, and as a matter of fact, have had "Laying Out for Boilermakers" on hand for some years now. However, the section on the locomotive boiler by W. E. Joynes seems rather advanced for our apprentices and I wonder if there is anything else that you could recommend to us that treats the subject somewhat simpler?—G. A. H.

A.—I would suggest that you contact the apprentice supervisors of other railroads who have apprentice courses. There are several who have very fine courses for boilermaker apprentices.

I do not know of any textbook dealing with the subject of laying out for boilermakers that would answer your purpose.

The general practice is for the apprentice supervisor to originate a selected course, starting with geometric problems, then simple layouts in which the apprentice completes the third view, followed with simple layout problems; illustrating the three methods of development; first, parallel line construction, second, triangulation and third the radial line method of development, following this with problems relating directly to boiler work.

Such a course could be taken from the article "Elementary Plate Layout" starting in the June, 1934, issue of the Boilermaker and followed by Practical Plate Development starting the March, 1935, issue of the same publication.

The Causes of Cinder Cutting

Q.—What is the cause of the cinder cutting of the tubes and flues of a locomotive boiler at the firebox end and how can this trouble be overcome?—J. H.

A.—Cinder cutting of tubes and flues at the firebox end of a locomotive boiler generally takes place at the bottom of the tube and flues directly ahead of the firebox tube sheet, and is due to the high velocity of the forced draft entering the tubes and flues causing the unburned cinder to cut and gradually wear the tubes and flues thin, until the pressure around the tubes breaks through causing a leak.

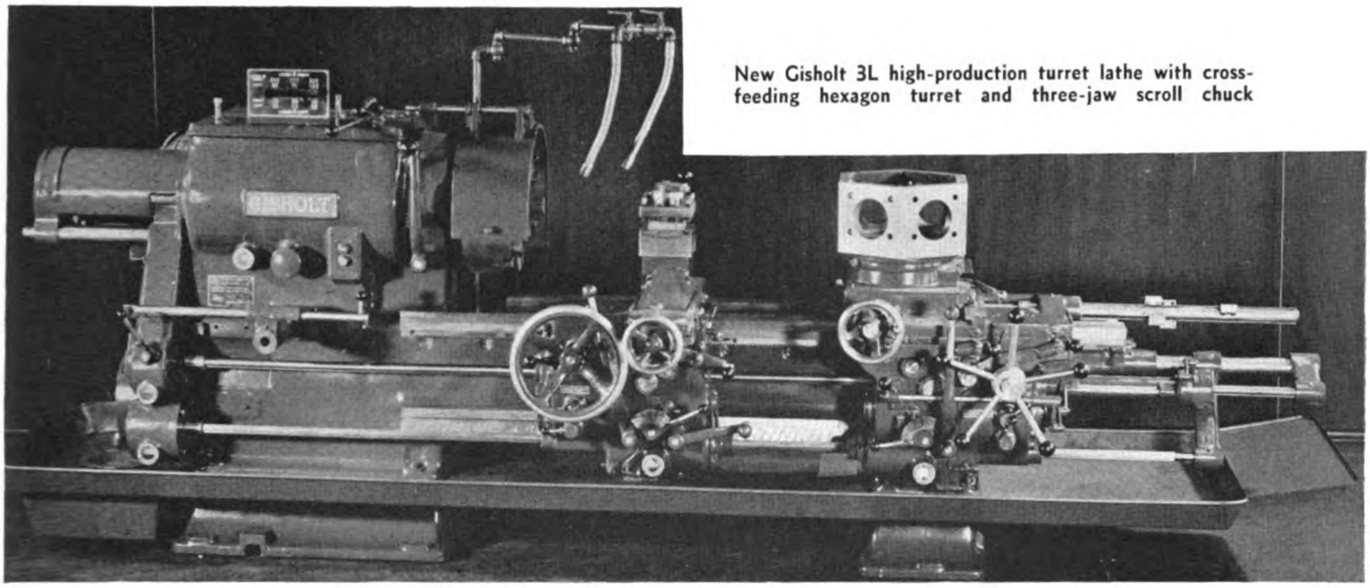
Cinder cutting is often caused by the use of an improper arch and can often be remedied by a change in the arch-brick assembly. On locomotives where this trouble cannot be overcome, it can be reduced to a great extent by applying heavier gage safe ends on new or replacement tubes and flues.

Improved High-Production Turret Lathes

Many new refinements to improve the performance and ease of operation, increase machine life and further extend its field of usefulness have been incorporated in the new Gisholt 1L, 2L and 3L high-production turret lathes, built by Gisholt Machine Company, Madison, Wis. They have bar capacities ranging from 2½ in. diameter to 4½ in. diameter and from 36 in. long to 48 in. long. The lathes have a swing over the ways ranging from 19 in. to 26 in. and employ chucks ranging from 12 in. in diameter to 21 in. in diameter. They are intended for both high production of similar pieces and small lot jobbing of various types of work, and are equally well adapted to both bar work and chucking work.

High-carbon alloy steel ways are a feature which give hardened bearing surfaces on all sides, including the top or main bearings, the sides for alinement and gibbing, and the bottom for clamping.

The strongly braced headstock is cast integral with the bed casting, which makes an exceptionally rigid construction. The headstocks for all three models have 12 different spindle speeds, the normal range of which in the 1L and 2L is from 20 to 486 r. p. m., and for the 3L is from 12 to 333 r. p. m. A direct reading speed plate mounted on the headstock tells the operator at a glance the r. p. m. at which the spindle is running.



New Gisholt 3L high-production turret lathe with cross-feeding hexagon turret and three-jaw scroll chuck

The spindle is mounted on precision-type tapered roller bearing and all shafts in the headstock, as well as the aprons, are mounted on anti-friction bearings. The gears are made of high-carbon chrome-molybdenum steel, hardened, and the tooth contours ground to give perfect rolling bearings and quiet operation. The high-speed gears are helical type. A double-multiple disc clutch is used for starting and reversing the spindle, and a powerful multiple-disc brake automatically stops the spindle when the machine is shifted into neutral. The spindle nose is American standard flanged Type A1.

The feeds and rapid traverse are controlled at each carriage independently of each other. Sixteen reversible power feeds in two ranges of eight each are available for both longitudinal and cross feeds of the cross slide or the cross-feeding hexagon turret. The longitudinal feeds range from .004 to .136 and the cross feeds range from .002 to .068 in. on the 1L machine and .002 to .084 in. on the 2L and 3L machines. The levers for engaging the feeds on the carriages have direct reading feed plates, which tell the operator at a glance the feed he is using in thousandths of an inch. The cross-feed screws on the cross slide and also on the cross-feeding hexagon turret have a large diameter dial graduated in one-thousandths of an inch, which permit the operator to feed to close dimensions and assist him in making quick set-ups.

A safety shear pin in the feed train on each carriage protects the feed gears against overload due to tool failure or accident and a safety friction affords similar protection to the rapid traverses. All apron gears are made from alloy steel and heat treated.

Multiple vee-belt motor drive is standard on all three models and the motor is mounted on the top of the headstock. The drive pulleys are balanced on Gisholt balancing machines, assuring vibrationless operation. Standard motor recommendations for the 1L machine are up to 10 hp. For the 2L and 3L machines, the motor recommendations are up to 15 hp. For high-speed operation, 15 hp. motors are recommended for the 1L and 20 hp. motors for the 2L and 3L machines. The motor is controlled by a conveniently located start and stop switch built into the headstock.

Rapid traverses are supplied for the longitudinal travel of both carriages and also for the in and out travel for the cross slide on the side carriage. The rapid traverse levers are provided with colored knobs for the operator's convenience.

All three machines are equipped with either fixed-center hexagon turret or cross-feeding hexagon turret. The fixed-center hexagon turret is recommended for work occurring in sufficient quantities to employ multiple tooling such as multiple turning heads and piloted boring bars. The cross-feeding turret is particularly efficient on small lot work where the production is too small to absorb the set-up time for multiple tooling. This turret may also be locked on center and used with piloted turning heads and piloted boring bars with the same effectiveness as a fixed-center hexagon turret machine. The cross-feeding hexagon turret employs simple tools such as single point boring bars, single point tool holders, etc. Holes are bored by adjusting the turret off center the desired amount. This not only provides an efficient method for handling small lot work and also varied types of work but it also keeps the tool cost at a minimum.

The available attachments include a built-in taper attachment for the cross slide which is provided with a standard guide plate for cutting tapers up to 1½ in. per ft. and 12 in. maximum length, or special guide plates may be furnished for tapers up to 3 in. per ft. and 6 in. maximum length. Tapers may be cut at any point within the travel of the cross slide. The hexagon turret taper attachment is also available, which is of the heavy-bed type design and permits cutting tapers or taper bores up to 8 in. taper per ft. and 12 in. maximum length.

The new type collet chuck is the push-out type with a four-split master collet and pads. The new design permits collet pads to be easily changed without removing the collet hood or master collet from the spindle. Thread chasing attachments are available for both the side carriage and for the hexagon turret carriage. They are of the leader and follower type and are designed for cutting extremely smooth and accurate threads.

Compound rests with power angular feed are available for all three machines. The compound rest is mounted on the cross slide and has 300 deg. of adjustment and may be set at any angle for machining angular surfaces such as the faces of bevel gears, etc. The compound slide has a graduated micrometer dial with a handle for setting the slide to the desired position. The compound has a dial graduated in degrees which facilitates setting to the proper angle.

These turret lathes are supplied with automatic lubrication to all important bearings.

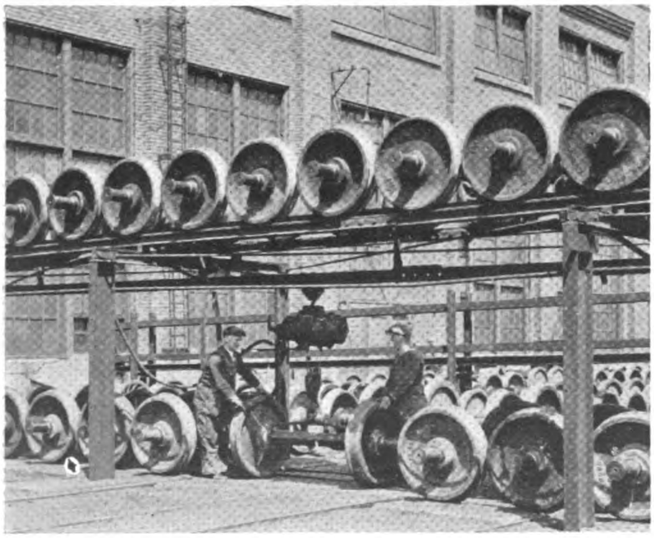
With the Car Foremen and Inspectors

Handling Devices at

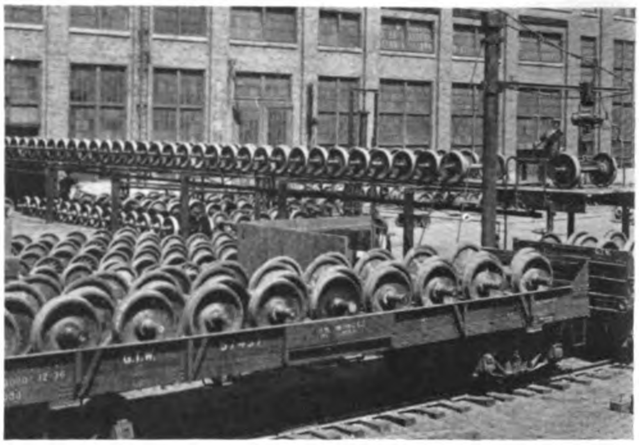
Battle Creek Wheel Shops

THE car-wheel shop of the Grand Trunk Western at Battle Creek, Mich., is notable not only for the compact and efficient arrangement of machinery, but for the many labor-saving devices developed for handling wheels and axles both inside and outside the shop. Machine equipment in this shop includes two axles lathes, one boring mill, two journal lathes, one wheel lathe and one wheel press. Because of the limited amount of floor space, approximately 4,500 sq. ft., much of the wheel handling is done on one main elevated ramp for mounted wheels and two elevated wheel chutes, one for incoming new wheels and the other for outgoing scrap wheels. The entire operation is designed for direct movement of the wheels and axles through the shop, without the interference of backward or cross travel and with automatic air-operated devices replacing manual labor wherever possible.

For example, referring to the first illustration, it will be observed that mounted wheels, loaded in special cars at various points on the Grand Trunk Western, are received at Battle Creek shops and the wheels unloaded on the elevated track or wheel ramp, which extends into the shop within 12 ft. of the wheel press. This track has a slight incline, which causes the wheels to roll by gravity to the end of the track in the shop, where an air-operated elevator cage automatically lowers them to the ground track and they fall on taper wedges, then rolling forward to the wheel press. Necessary repair operations on the



Car wheels are turned for movement to storage tracks by means of an Ingersoll-Rand two-ton air hoist and mono-rail suspended under the main wheel ramp



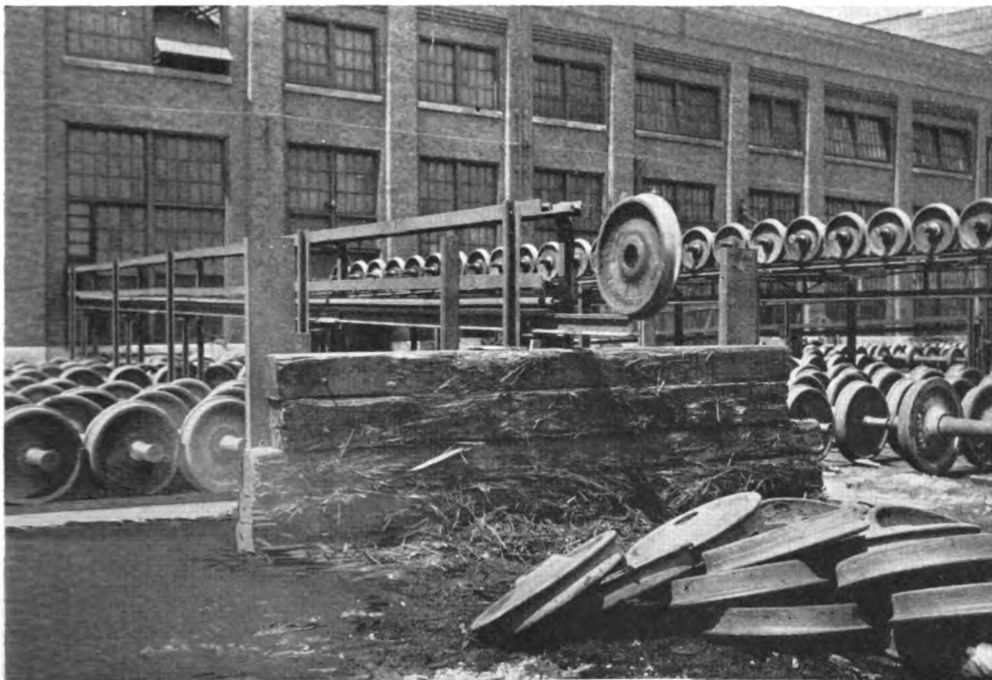
Outside equipment for handling car wheels at the Grand Trunk Western Shops, Battle Creek, Mich.

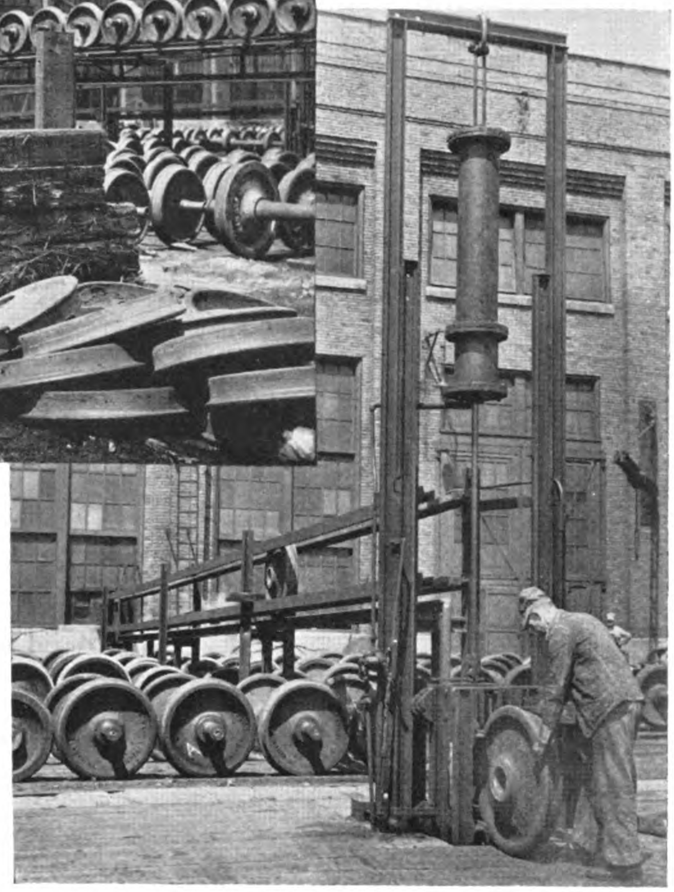
wheels and axles are performed, after which they are reassembled and rolled out of the shop on the track underneath the elevated ramp, to be placed on storage tracks or loaded in outgoing wheel cars. This method of operation saves the obvious interference and confusion which can hardly be avoided when an attempt is made to handle both incoming and outgoing wheels on the same track at ground level.

In the view of the elevated wheel ramp is shown the mono-rail and Ingersoll-Rand two-ton air hoist used in turning mounted car wheels for movement to storage tracks. The third illustration is a composite view showing the ingenious and effective elevated wheel chutes used in handling individual car wheels. New wheels, received in special cars from the manufacturer, are unloaded with a magnet crane and placed on the platform immediately adjacent to the wheel chute shown at the right. New wheels are simply rolled, one at a time into the air-operated elevator cage, which raises them to the level of the wheel chute down which they roll into the shop and within a few feet of the boring mill. Similarly, scrap car wheels, removed from axles at the press inside the shop, are raised by an air-operated elevator cage to the upper end of an elevated wheel-delivery chute, the outer end of which is shown at the left in the third illustration. A scrap car wheel is shown in the illustration just on the point of dropping from the end of the chute. These car wheels are then loaded on an outgoing scrap car by means of a magnet crane.

It will thus be observed that the use of the main elevated ramp and the two wheel-delivery chutes not

Wheel chutes: Left—For delivering wheels from the shop; Below—For delivering new wheels to the shop





only conserves floor space, both inside and outside the shop, but saves a great amount of manual labor, and hazard involved in rolling mounted and unmounted wheels from one point to another about the shop. By the present method, only a small amount of manual labor is involved in handling individual wheels at each end of the wheel chutes and in rolling finished mounted wheels in one direction out of the shop.

Construction of the Elevated Ramp and Wheel Chutes

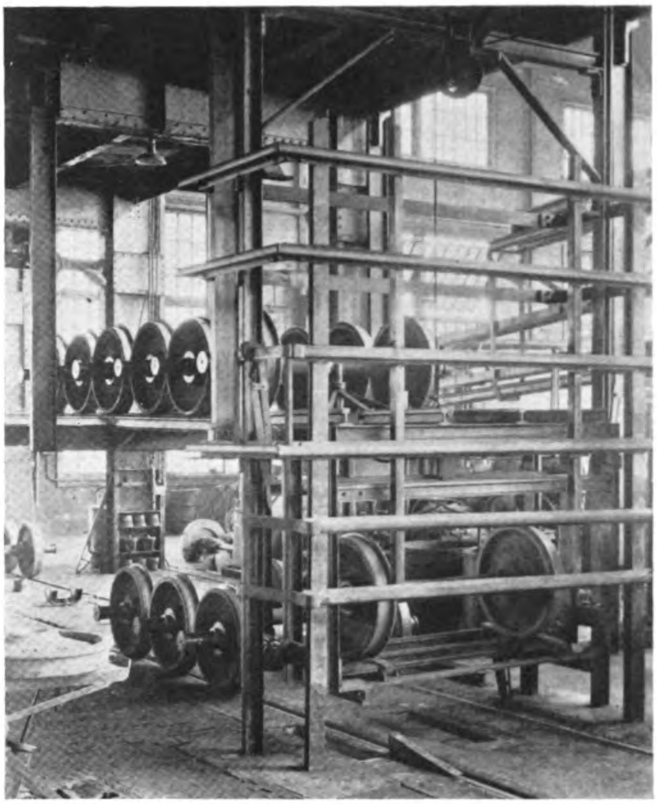
The main elevated wheel ramp is made of 80-lb. steel rails, supported on cross rails which are welded at each end to 10-in. vertical I-beams, set in a concrete base and spaced 9 ft. apart, with 18-ft. spans. One-inch cross-tie rods are provided to stiffen the structure, the outer end of which, adjacent to the wheel cars, is 9 ft. high. The rails are inclined about 1 ft. in 100 ft. so that the wheels move by gravity into the shop. A strongly-constructed jib crane, with 18-ft. boom, 16 ft. high, is equipped with an Ingersoll-Rand two-ton air hoist for handling wheels.

In unloading a car of mounted wheels, received at the shop for reconditioning, a wooden extension platform is installed, so that by means of a short lift and slight swing of the boom, the wheels can be readily placed on the extension platform and started down the wheel ramp. When loading reconditioned mounted wheels, this wooden platform is removed and the wheels easily lifted from the outgoing ground track into the car, using the same jib crane and air hoist. The upper deck of the main wheel ramp is covered with plank between the rails to serve as a safe walkway when it is occasionally necessary for shop men to pass over it. The mono-rail, suspended under the center of the main wheel ramp, is equipped with a second two-ton Ingersoll-Rand hoist which provides easy means for turning a pair of wheels at any point on the outgoing track.

In the fourth illustration, mounted car wheels are stopped at the inner end of the main wheel ramp by a well-braced 3-in. vertical rod, operated by an 8-in. by 12-in. air cylinder and extending just high enough to contact the leading car axle at its center. Just beyond the rail ends is an air-operated elevator cage of welded rail construction which is capable of vertical movement in a rugged steel frame, being quided by suitable rollers bearing against the corner posts and raised and lowered by cable extension from a 10-in. by 84-in. air cylinder. In the upper position, the elevator cage track lines up with that on the wheel ramp so that, when the holding piston rod is withdrawn, one pair of wheels rolls into the cage, where it is centered by a slight depression in the hinged supporting rails. When the cage reaches its lowest position, the wheel-supporting rails are given a slight tilt by contact with the shop floor and the wheels automatically roll onto a pair of taper wedges and thence down the track a short distance to the wheel press. The operation of the air cylinders which move the holding piston rod and also the elevator cage is controlled by air valves located within easy reach of the operator at the wheel press who can get another pair of wheels whenever needed by simply operating these valves and without leaving his place at the press.

The car-wheel press, operated by two men, is equipped with two roller-type wheel carriers and a special block which enables the wheels to be pressed on without turning the axle end-for-end, by first pressing the axle into one wheel and then slipping the block over the journal and pressing the other wheel on the axle.

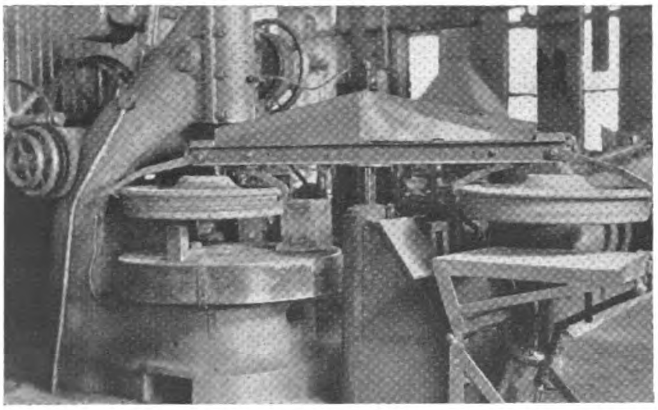
Referring again to the illustration showing the wheel chute for delivering new wheels to the shop, the construction of this device will be apparent. It consists



Air-operated elevator cage for dropping incoming wheels to the floor preliminary to pressing off

essentially of welded rail construction, the 10-in. by 70-in. air cylinder being suspended from the top of a rectangular rail frame 16 ft. high with the side rails separated 34 in. The elevator cage, is directly connected to the air-cylinder piston rod and is guided in vertical movement by four 3-in. rollers which contact the sides of the framework. The wheel chute runway is of simple construction, the weight of the wheels being carried on a single rail which contacts the treads, with two rails on each side serving as a guide to keep the wheels upright. The inclination of this runway also is 1 ft. in 100 ft. and it extends through the shop wall, delivering wheels to within a few feet of the boring mill.

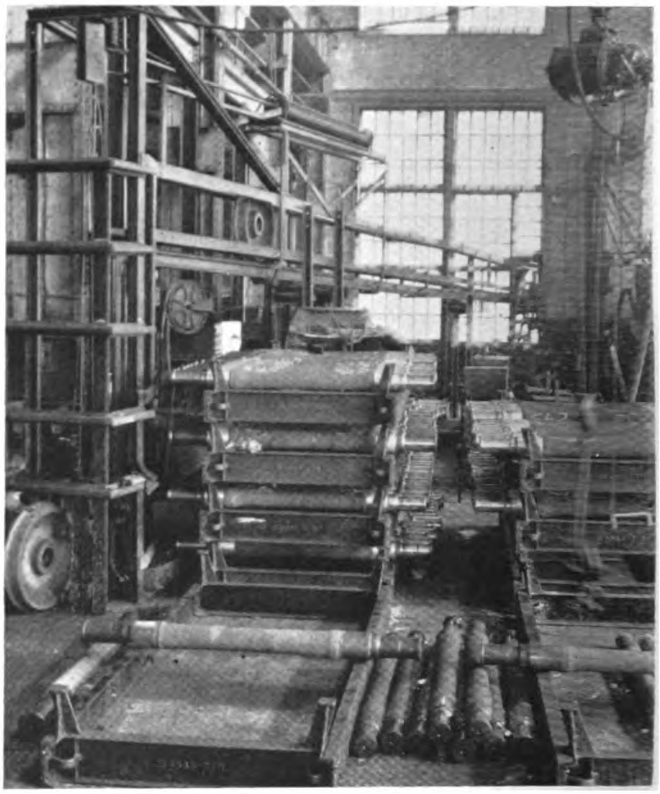
This wheel chute is entirely automatic in operation. Each wheel, as received at the chute, is simply rolled into the cage and when all the way in, it trips an air valve which admits air to the operating cylinder, thus raising the cage to its upper position in which the wheel



Balanced air lifting device used in handling wheels at the boring mill

rolls by gravity onto the inclined runway and on into the shop. The wheel is stopped at the end of the chute by side friction of the two upper guiding rails which are held a fixed limited distance apart by air pressure from a small 6-in. air cylinder. When it is desired to release a wheel from the chute, this can be done by means of a foot-operated air valve which releases pressure in the holding cylinder and permits one of the wheels to roll out to the shop floor where it can be easily guided to the wheel press or placed in a temporary adjacent storage space.

This brake device provides a positive safety feature but, in addition, two electric signal lights have been in-



Scrap-wheel elevator and delivery chute—Axle carriers are seen in the center and foreground

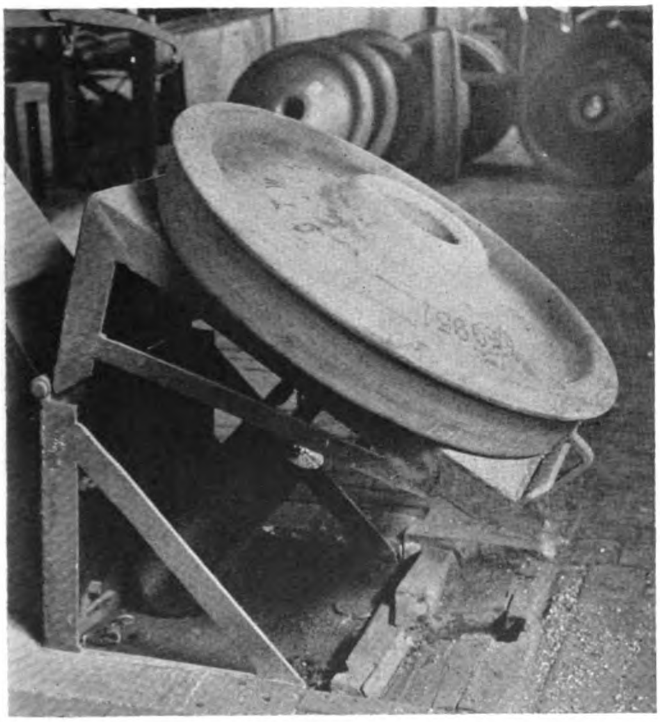
stalled in such a way that, in delivering new wheels into the shop by means of the wheel chute, when the wheel first enters the outside elevator cage a white light is shown at this point and a red light shows at the delivery end of the chute. When the wheel leaves the chute both lights are out. Shop men thus know by signal-light indication when a car wheel is coming down the chute into the shop.

A similar wheel-elevator cage, but with a horizontal-acting air cylinder having a steel cable connection to the cage, is installed in the shop adjacent to the wheel press, where scrap wheels can be easily rolled into the cage, raised to the elevated wheel-delivery chute and rolled by gravity through the shop wall and out to the pile of scrap wheels, as shown in one of the illustrations mentioned. The inclination of the wheel-supporting rail in the scrap-wheel chute has to be slightly greater than that designed for handling new wheels, owing to the somewhat greater resistance to free rolling.

The balanced air lifting device, used in handling wheels at the boring mill, as shown in two of the illustrations, was not originally developed at Battle Creek

shops, but has been adapted to the local shop requirements. It consists essentially of a hinged wheel-lifting unit used to raise new wheels from a vertical position on the shop floor to a horizontal position on a level with the boring-mill table, a balanced rotating steel frame serving to place a new wheel on the boring-mill table, while the bored wheel is being removed. The hinged wheel-lifting unit, or supporting stand, as it is called, is operated by a 6-in. by 16-in. air cylinder. It is designed so that, when in the lowered position, the wheel flange rests directly on the shop floor and wheels may be readily removed from it, or rolled into position and leaned against it.

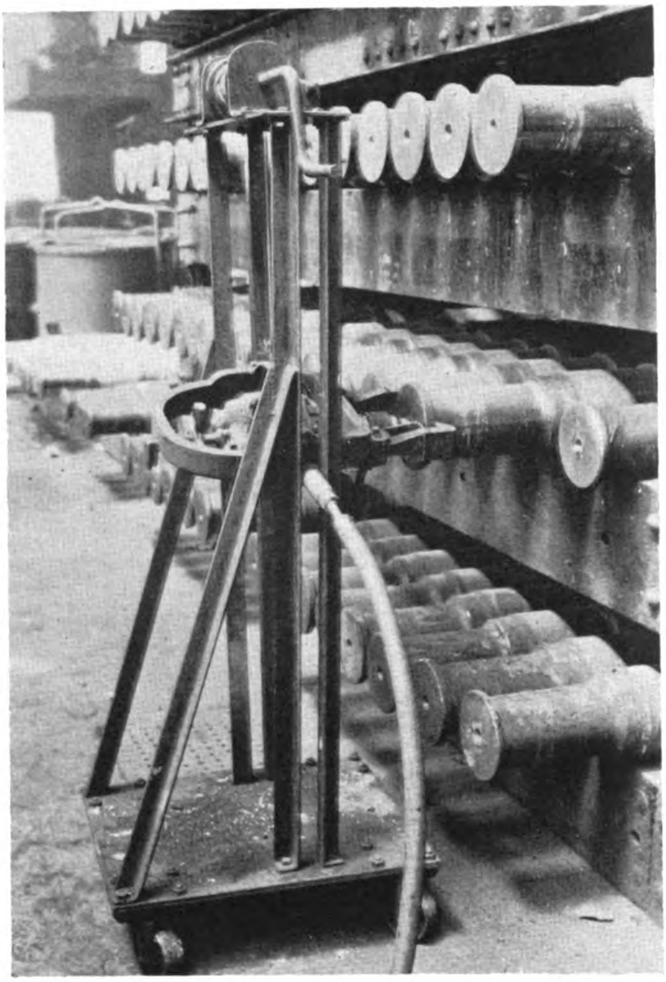
The balanced light steel frame used in transferring wheels is about 70 in. long. It is equipped with three-point tongs at each end and is supported at the center on the piston rod of an air cylinder with 6 in. vertical lift and is arranged for easy rotation on this supporting piston rod. The three-point tongs automatically spread and grip the wheel flanges when the supporting beam is lowered. By applying air pressure in the cylinder both wheels are lifted simultaneously and the new wheel may be easily swung through a semi-circle while the finish bored wheel is transferred to the hinged stand. By re-



Hinged wheel-supporting stand, which is operated by a 6-in. by 16-in. air cylinder

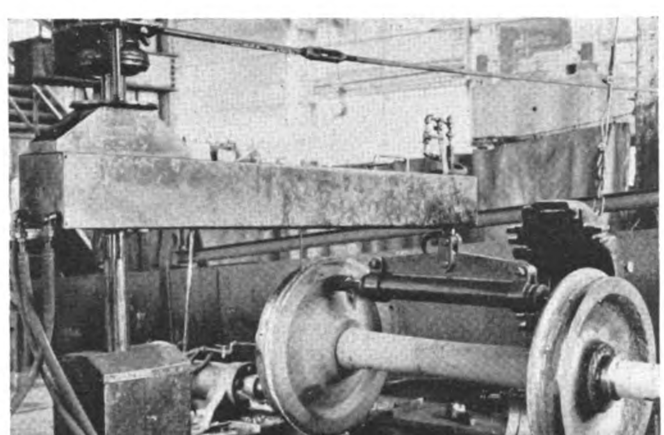
leasing the tongs and again elevating the supporting beam it may be swung out of the way so that the new wheel may be centered in the boring-machine chuck and rebored. The finished wheel is lowered to the floor during this operation and rolled to the wheel press ready for application on an axle. Control of both air cylinders used in handling wheels at the boring mill is provided by means of air valves located within easy reach of the operator.

A special air-operated swing crane gives effective service in handling mounted car wheels to and from the journal lathe. This is in reality a combined wheel hoist and swing crane with a 7-ft. steel boom arranged to swivel about a 3-in. vertical shaft which is capable of



Portable device for reboring axle centers to the correct angle

12 in. movement up and down by means of a 16-in. air cylinder mounted under the shop floor. The vertical shaft is supported at both the top and bottom by bearings of special design to reduce friction, and it will be observed that tie rods which position the upper bearing are equipped with turn buckles to give accurate adjustment so that the boom will swing easily in either direction, but be sufficiently well balanced so as not to be moved by its own weight.



Special equipment for handling mounted car wheels to and from the journal lathe

Referring to the illustration, it will be noticed that the outer end of the boom is equipped with a double-acting air cylinder, 4 in. by 39 in., with special jaws on the piston-rod ends to contact the wheels firmly below the flanges and thus enable them to be lifted from the shop floor and readily swung into position between the lathe centers. This double-acting air cylinder and the supporting bar and link are so designed that the wheels are held in a well balanced horizontal position. The actual work of centering the axle in the lathe is easily performed, owing to the provision of an axle rest bolted to each tail stock and bringing the axle centers practically in line with the lathe centers without numerous up-and-down adjustments of the crane height. Air-operating valves are within easy reach of the lathe hand, and the use of this type of wheel hoist and swing crane enables car wheels to be handled into and out of the journal lathe quickly and with a minimum of manual labor.

Axle Carriers and Centering Device

To facilitate handling axles about the shop, special axle carriers have been developed which not only tend to avoid journal damage but enable axles to be handled with the overhead traveling crane and stacked in piles four or more high, which conserves floor space. The axle carriers, 62 in. wide by 12 ft. long, consist of two 10-in. side channels, joined at the ends by steel castings, which are in effect 10-in. channels with an integral steel band at each end for engagement with the crane hook and also an upward projecting steel foot at each corner which serves to prevent the axles from rolling off the carrier and also enables the carriers to be stacked when desired. In addition to other advantages, these carriers enable axles of similar size to be segregated and moved as a unit above the shop, thus saving time and labor in rehandling. Each carrier holds 15 A. A. R. standard axles.

The two journal lathes used at this shop are equipped with roller bearing centers, floating chucks, center rests attached to the tail stocks, and turret heads holding two rollers, two turning tools and one fillet tool. An average of 12 axles per lathe are turned out during each 8-hr. day. Lathe hands caliper the wheel fits and mark each axle with the exact micrometer size, which saves recalipering by the boring-mill operator.

The axle center reboring machine, shown in one of the illustrations, is a portable device which assures the maintenance of accurate axle center holes, machined smooth and to the correct angle of 60 deg. corresponding to that of the lathe centers. This device consists of a 19-in. by 22-in. base plate mounted on small roller wheels and supporting a 1½-in. angle framework which is 49 in. high and braced as shown in the illustration. A small windlass at the top of this frame supports, by means of a light wire cable, a special frame carrying an air motor which may thus be moved up and down to suit the height of the axle center being bored. The handles of the air motor project through the angle sides which serve to guide the frame and the motor in its vertical movement. The air-motor supporting frame is equipped on the outer end with two dogs which engage the journal collar on opposite sides and are held in position under spring tension so that, when the air motor and boring tool are centered, operation of the motor feed screw will bring pressure against the cutter and rebore and retrue the axle center to the correct angle.

When the Battle Creek car-wheel shop is operating on a full production basis with a wheel gang consisting of four machinists, one car man and one car-man helper, the average production is about 460 pair of cast-iron and 90 pair of steel wheels per month.

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

450—*Q.—What is the duty of the service slide valve?* A.—It opens and closes ports and passages between: (1) Auxiliary reservoir and the chamber on the face of the release piston past the graduating valve in application position; (2) quick-service volume and atmosphere in release position, or between this volume and brake pipe through the graduating valve in preliminary quick service position; (3) between the brake pipe and displacement reservoir (through quick action service limiting valve) during the first stage service application; (4) auxiliary reservoir past the graduating valve to the displacement reservoir in service position; (5) between the auxiliary reservoir and the release insuring valve with the slide valve in release position and between the slide valve exhaust and the release insuring valve with the slide valve in application position.

451—*Q.—What is the purpose of the service piston return spring and cage?* A.—To prevent movement of the service piston beyond release position unless the brake pipe pressure is about 3 lb. higher than the auxiliary reservoir.

452—*Q.—What prevents the possibility of the graduating valve being blown off its seat?* A.—Brake pipe pressure under the graduating valve is cut off by the slide valve.

453—*Q.—What is the duty of the emergency reservoir charging and ball check?* A.—It permits the brake pipe air to charge the emergency reservoir and prevents back flow.

454—*Q.—What is the duty of the supply reservoir charging and ball check?* A.—It permits the flow of air from the brake pipe to the supply reservoir but prevents back flow.

455—*Q.—What is the purpose of the back flow and ball check?* A.—It serves to prevent flow of displacement reservoir air into the brake pipe at such time that the displacement reservoir pressure is higher than the brake pipe.

456—*Q.—What is the function of the release piston and slide valve?* A.—It opens and closes the passage between the auxiliary reservoir and the emergency reservoir and between the displacement reservoir and exhaust.

457—*Q.—What is the function of the quick service choke plug?* A.—It controls the rate of flow of the brake pipe air to the quick service volume during preliminary quick service of the displacement reservoir during the first stage service.

458—*Q.—What is the purpose of the duplex release valve?* A.—It permits manual reduction of the auxiliary and emergency reservoir pressure.

459—*Q.—For what purpose is the quick service volume?* A.—It provides a predetermined volume into which the brake pipe air flows to initiate preliminary quick service.

460—*Q.—What is the purpose of the preliminary quick service exhaust choke plug?* A.—It controls the continuous exhaust of the quick service volume air to the atmosphere and provides the secondary quick service function.

461—*Q.—What is the purpose of the graduated release choke?* A.—It controls the rate of recharging the auxiliary reservoir from the emergency reservoir during quick recharge and graduated release.

462—*Q.—What is the duty of the quick service limiting portion?* A.—It terminates quick service activity after a 14-lb. brake cylinder pressure is developed.

463—*Q.—What does the emergency portion contain?* A.—Emergency piston, emergency graduating valve, emergency slide valve, emergency piston return spring, emergency piston spring, emergency valve spill over check valve and ball check, accelerated release check valve and ball check, diaphragm spring and slide valve strut, charging choke plug vent piston choke and vent valve cylinder cover choke.

464—*Q.—What is the duty of the emergency piston?* A.—It operates the graduating valve when a service brake pipe reduction is made and also the slide valve in an emergency.

465—*Q.—What is the duty of the emergency graduating valve?* A.—It controls the flow of air from the quick action chamber to the atmosphere during emergency application.

466—*Q.—What is the duty of the emergency slide valve?* A.—It controls the flow of air from: (1) The quick action chamber through the graduating valve to atmosphere during service application, (2) the quick action chamber to vent valve piston during emergency application, (3) the emergency reservoir to the spring side of the emergency valve except during emergency application, (4) the spring side the emergency valve to atmosphere during emergency application, (5) the displacement reservoir past the accelerated release check to the brake pipe during the release after an emergency, and (6) the displacement reservoir to the safety valve during a service application and cuts off this connection during an emergency application.

467—*Q.—What is the duty of the vent valve and piston?* A.—To vent brake pipe air to the atmosphere during an emergency application.

468—*Q.—What is the purpose of the emergency piston return spring and cage?* A.—It returns the emergency piston during release cycles from accelerated release to normal release position when the quick action chamber pressure recharges to approximately brake pipe pressure.

469—*Q.—What is the purpose of the emergency piston spring?* A.—To stabilize emergency portion against undesired emergency.

470—*Q.—What is the duty of the emergency valve?* A.—It connects the emergency reservoir air to the displacement reservoir during the emergency application.

471—*Q.—What is the purpose of the spill-over check valve and ball check?* A.—To provide against overcharge of the quick action chamber.

Improved Power-Driven Forge Hammers

The line of power-driven forge hammers formerly made and sold for many years as Moloch power hammers, has been improved in a number of important details and is now being manufactured and sold by the D. J. Murray Manufacturing Company, Wausau, Wis. This hammer is made in five different sizes for general forging work, namely, 25-lb., 50-lb., 100-lb., 250-lb., and 500-lb., the 100-lb. and 250-lb. sizes being illustrated. In railway forge shops these hammers are well adapted to a wide variety of operations, including the forging of such parts as chisel blanks, coil-spring ends, wheel-lathe tools, brake hangers, spring hanger clips, etc.

The improved Murray hammer is said to be extremely powerful, yet simple in design and easy to operate. The ram is held in rigid alinement with the frame, and V-ram guides are of ample size, made of semi-steel and easily adjustable for taking up wear. This arrangement enables the constant maintenance of full length bearing and assures accurate alinement of the dies. The ram connection provides a cushion at the upper extremity of the stroke and imparts a multiplied impetus to the downward stroke. Steel castings, alloy steel forgings, and high grade steel springs and arm pins are used in this assembly. The bearings are lined with removable bushings and the crank bearing is extra long and split to allow taking up for wear. The friction clutch spider is of the cone type, leather faced, and gives the operator accurate control of speed and weight of blow. The pulley has a removable bushing on a steel shaft. The friction clutch spider is held in position on the shaft by a taper pin which can be removed in a few seconds.

The dies, made of special die steel, accurately machined and tempered, are keyed in machined slots and set at an angle which enables the working of long bars without interference with the frame. Standard dies are either flat or rounded on the face. Unless otherwise specified, they are furnished with a flat forging face on the three larger sizes.

The pulley and rear shaft bearing are lubricated by means of a grease cup working through a hollow shaft. The front shaft bearing is lubricated with a grease cup, other friction points being hand-oiled and easily accessible.

Murray hammers are adaptable to a wide range of work without adjustment, such as alternate blows on the flat and edge of rectangular stock. Yet adjustment for different thicknesses of dies and material is provided. A split steel crosshead, clamped to the steel connecting rod can be shifted up and down quickly and easily.

Improved Murray 100-lb. and 250-lb. power-driven forge hammers

The 100-lb. hammer, illustrated, has a die of face 6 in. by 3 in., and a forging capacity for general work up to 4 in. round, the throw of the crank being 6½ in., the maximum stroke 12 in., and throat depth, 14½ in. The machine is belt-driven, with a pulley speed of 275 r.p.m. The 250-lb. hammer, which is provided with direct motor drive from a 5-hp. electric motor, has a die face 8 in. by 4 in., and forging capacity up to 6 in. round. The throw of the crank is 8 in., maximum stroke 15 in., depth of throat 15½ in., and pulley speed 220 r.p.m.

High Spots in

Railway Affairs . . .

Progress in Railroad Legislation

The Senate has completed its work on transportation legislation for this session of Congress. On May 25 it adopted the Wheeler-Truman bill, which puts water carriers under Interstate Commerce Commission regulation and codifies the Interstate Commerce Act. On May 27 and May 29 it passed, respectively, the railroad reorganization court measure, and the Chandler voluntary reorganization bill. The former measure establishes a special court of five members for railway reorganization proceedings and contains provisions intended to insure the soundness of the financial structures emerging from the reorganization process. The latter measure applies only to the Baltimore & Ohio and the Lehigh Valley and, if the House, in conference agrees to the Senate amendments, will assure that the large amount of work already done on the debt-adjustment plans of these two roads will not go for naught. The only one of the three bills which promises any basic correction in transportation conditions is the Wheeler-Truman bill. If approved by the House, the two-year studies of the relative economy of various modes of transport and of government aids to transport, which the bill requires to be made by a three-member board appointed by the President, promises even more in ultimate fairness to the railroads than may be expected in practical results from the regulation of water carriers by the Interstate Commerce Commission. The prospects for passage by the House at this session are uncertain.

Motor Trucks Getting the Business

During the first quarter of this year revenue freight-car loadings were 6,990,264, an increase of 5.4 per cent over the loadings for the same period in 1938. The American Trucking Association publishes monthly reports of the freight tonnage transported by motor carriers. In January of this year, for instance, reports from 231 motor carriers in 41 states, showed a tonnage of 780,460, an increase of 26.5 per cent over the same month in 1938. In February, 212 motor carriers in 40 states transported 797,031 tons, an increase of 25.7 per cent for the same carriers over February, 1938. In March, 210 motor carriers in 38 states transported an aggregate of 896,324 tons, an increase of 23.4 per cent, as compared to March, 1938. It is difficult to combine these figures with accuracy because of the different number of carriers involved in each of the three months, but it would seem that for the three months the increase in tons carried by the motor trucks was between 24 and 25 per cent, as compared to an increase of 5.4 per cent in revenue freight car loadings.

McManamy and Meyer Leave I. C. C.

Probably no other Interstate Commerce Commissioner has been so well known to the mechanical department officers and employees as Frank McManamy. Moreover, in a group which is noted for hard workers, it is doubtful whether any other commissioner has ever worked harder or more faithfully on the job than Mr. McManamy. He was also one of the very few commissioners who have had extensive practical railroad experience. Just why the Administration could not see its way clear to continue him in service until his seventieth birthday will probably never be known to the general public. It is understood that Mr. McManamy will retire to a home which he has purchased at Daytona Beach, Fla. Almost at the same time, and on his own request, Commissioner Balthasar H. Meyer was released from service by the President, on May 1. Mr. Meyer served longer than any other commissioner in I. C. C. history, having held that office since January, 1911. He has opened an office in Washington as a consultant in transportation matters.

Purchases During First Quarter

The railroads have enjoyed better business thus far this year than they did in 1938, although the increase is not nearly as great as was anticipated early in the year. Increased revenues for the railways are naturally reflected in increased purchases, and it is not surprising, therefore, to find that purchases during the first quarter of this year were much better than for the corresponding period last year. According to the Railway Age, materials, exclusive of fuels, received from manufacturers in the first quarter of this year totaled $119,424,000, as compared with $89,850,000 during the first quarter of 1938, an increase of 33 per cent. Orders for new locomotives and cars from builders totaled approximately $20,680,000, as compared with $9,537,000 for the first quarter of 1938. Fuel purchases increased from $62,-830,000 in 1938, to $76,896,000 for the first quarter this year. While the total purchases for the first three months this year were 40 per cent less than for the first three months of 1937, they were larger than in any other corresponding period of the last nine years, except for that year.

A Great Leader Passes

Carl R. Gray, vice-chairman of the board of directors of the Union Pacific, who passed away on May 9, 1939, may well be regarded as one of the outstanding railway leaders of America. They said he retired when he gave up the presidency of the Union Pacific on October 1, 1937, but the interval between that time and his death was one of the busiest and most productive in his long railroad service. Thoroughly grounded in the techniques of railroading, because of his keenness, and the wide variety of experiences in climbing from the very bottom to become the chief executive of one of America's great railroads, he had an unusually thorough understanding of railroad problems. More than that, however, he understood human nature and knew how to exercise that fine type of leadership that inspired confidence and loyalty, as well as enthusiasm among his followers. During the past year and a half he worked unceasingly to bring about a satisfactory solution of the grave problems which the railroads as a whole are facing in this country today. He was, indeed, the railroads' minister-at-large, and the transportation industry has lost a leader of high ideals, with keen and far-sighted perception.

Safety in 1938

The National Safety Council announced the results of its twelfth annual award in the Railroad Employees' National Safety Contest on May 15. It takes considerable satisfaction in noting that there has been a renewal of interest in the safety program, since the results approximate more nearly those of the best safety year on the railroads, 1933, than has been true in recent years. The Union Pacific System again leads in Group A (50 million or more man-hours), thus topping this particular group for 11 out of 16 years. The Western Region of the Pennsylvania Railroad heads Group B (20 million to 50 million man-hours) ; the Chicago, St. Paul, Minneapolis & Omaha heads Group C (8 million to 20 million man-hours) ; the Duluth, Missabe & Iron Range, Group D (3 million to 8 million man-hours) ; the Detroit, Toledo & Ironton, Group E (1 million to 3 million man-hours), and the Lake Superior & Ishpeming, Group F (less than 1 million man-hours). In the Pullman Company auxiliary contest the Chicago Central Zone captured the first place. The records of the Pullman Buffalo shop surpassed those of the five other Pullman shops. Of the Class 1 switching and terminal roads the Ogden Union Railway & Depot Company led in Group A and the Lake Terminal Railroad Company led Group B.

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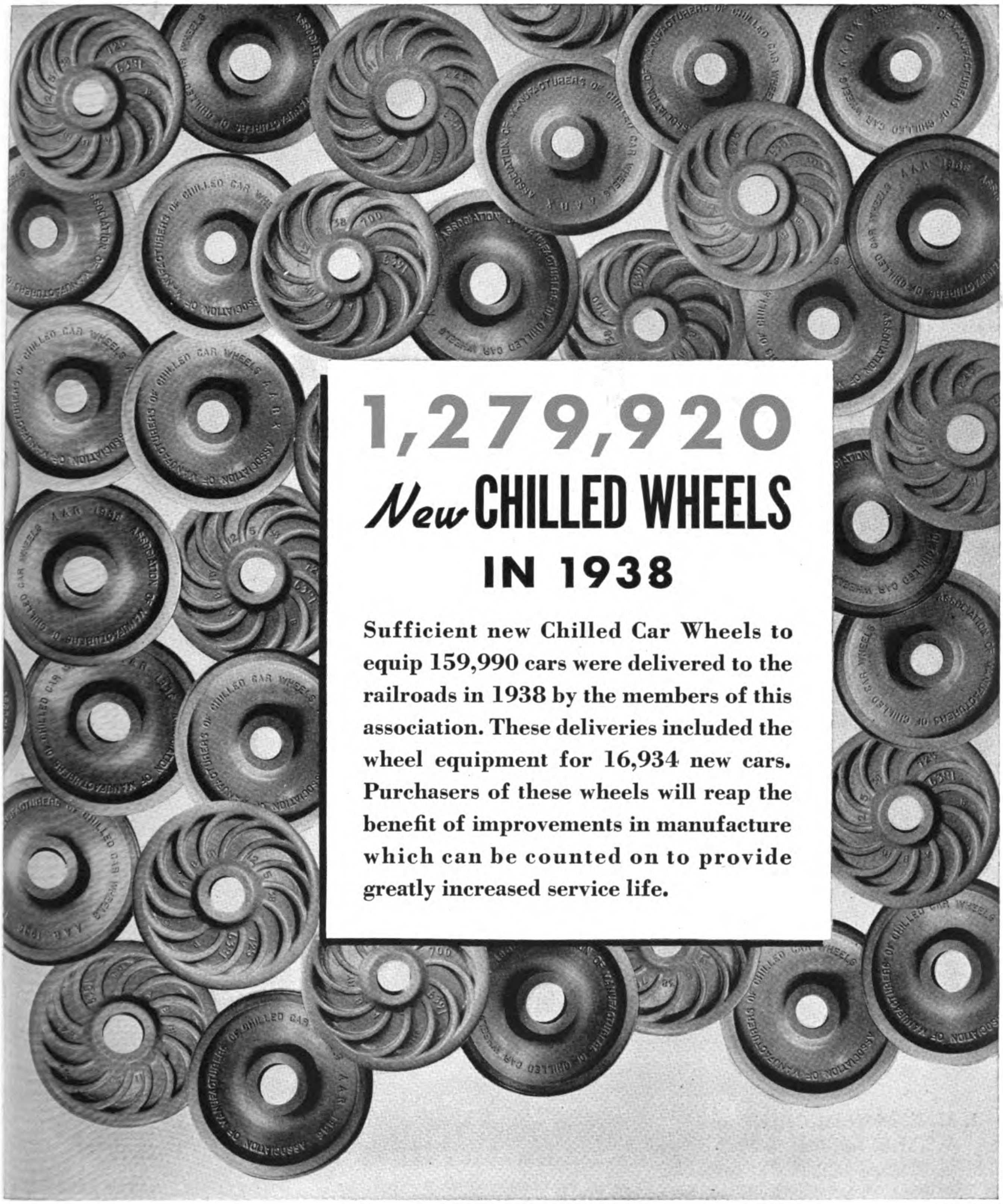

1,279,920

New CHILLED WHEELS

IN 1938

Sufficient new Chilled Car Wheels to equip 159,990 cars were delivered to the railroads in 1938 by the members of this association. These deliveries included the wheel equipment for 16,934 new cars. Purchasers of these wheels will reap the benefit of improvements in manufacture which can be counted on to provide greatly increased service life.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE,
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ORGANIZED TO ACHIEVE:
- Uniform Specifications
- Uniform Inspection
- Uniform Product

Among the Clubs and Associations

Mechanical Division Annual Meeting Program

THE sessions of the 17th annual meeting of the Association of American Railroads, Mechanical Division, scheduled to be held at New York, June 28 to 30, inclusive, will convene each morning at 9 a. m., Daylight Saving Time, at the Commodore Hotel and adjourn at 1 p. m. or as soon thereafter as possible, in order to give the members an opportunity to inspect the transportation exhibits at the New York World's Fair. The following is a program of the meeting:

WEDNESDAY, JUNE 28, 1939

Meeting called to order
Address by J. W. King, vice-president, operations and maintenance department, Association of American Railroads
Address by Chairman F. W. Hankins, chief of motive power, Pennsylvania
Action on minutes of annual meeting of 1937
Appointment of Committee on Subjects, Resolutions, Correspondence, etc.
Unfinished business
New business
Report of General Committee
Report of Nominating Committee
Discussion of Reports on:
Lubrication of Cars and Locomotives
Specifications for Materials
Wheels
Brakes and Brake Equipment
Adjournment

THURSDAY, JUNE 29, 1939

Meeting called to order
Discussion of reports on:
Arbitration
Prices for Labor and Materials
Tank Cars
Loading Rules
Couplers and Draft Gears
Car Construction
Adjournment

FRIDAY, JUNE 30, 1939

Meeting called to order
Individual paper on Operation of Diesel Locomotives, by H. H. Urbach, mechanical assistant to executive vice-president, Chicago, Burlington & Quincy
Discussion of reports on:
Locomotive Construction
Further Development of the Reciprocating Steam Locomotive
Joint Committee on Utilization of Locomotives and Conservation of Fuel
Election of members of General Committee
Adjournment

I. M. E. of Great Britain and A.S.M.E. to Meet in Fall

MEMBERS of the Institution of Mechanical Engineers of Great Britain and the American Society of Mechanical Engineers will meet at New York September 4 to 8. Joining also in this meeting will be the Institution of Civil Engineers and the Engineering Institute of Canada, who are meeting with the American Society of Civil Engineers. A single printed program will include the events for both the mechanical- and civil-engineering groups, who will join in an opening session on the afternoon of Labor Day, Monday, September 4, at the Engineering Societies Building. On the mornings of the succeeding days mechanical-engineering sessions will be held as follows: Tuesday, September 5, Marine Transportation; Wednesday, September 6, Railroad Transportation; Thursday, September 7, Highway Transportation, and Friday, September 8, Transatlantic Airplane Transport.

Two papers on Lightweight High-Speed Trains have been prepared for presentation at the Railroad Transportation session. William A. Stanier, chief mechanical engineer, London, Midland & Scottish Railway, London, England, will be the speaker for the British engineers, and Charles T. Ripley, chief engineer, Technical Board, Wrought Steel Wheel Industry, Chicago, for the American engineers.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago. Meeting October 17, 18, and 19, Hotel Sherman, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.
RAILROAD DIVISION.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.
MACHINE SHOP PRACTICE DIVISION.—Erik Aberg, editor, Machinery, 148 Lafayette St., New York.
MATERIALS HANDLING DIVISION.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.
OIL AND GAS POWER DIVISION.—M. J. Reed, 2 West Forty-fifth street, New York.
FUELS DIVISION.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

ASSOCIATION OF AMERICAN RAILROADS.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.
OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.
MECHANICAL DIVISION.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Annual meeting June 28, 29 and 30, at the Commodore Hotel, New York.
PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York. Convention of entire membership, June 14-15, Palmer House, Chicago.
MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4468 Oxford avenue, Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, Hotel Mayfair, St. Louis, Mo.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago. Meeting October 17, 18, and 19, Hotel Sherman, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMAN'S ASSOCIATION.—Roy MacLeod, Room 127, G. O. Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of each month, except May, June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association. Meeting third week in October, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—F. T. James, general foreman, D. L. & W., Kingsland, N. J. Meeting October 17, 18, and 19, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich. Annual meeting October 17, 18, and 19, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Annual meeting, October 17, 18, and 19, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August, September, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately, excepting June in Los Angeles and October in Sacramento.

RAILWAY CLUB OF GREENVILLE.—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—P. A. Bissell, 40 Broad street, Boston, Mass.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, 1255 Old Colony building, Chicago. Annual meeting October 17, 18, and 19, Hotel Sherman, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

TRAVELING ENGINEERS' ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

WESTERN RAILWAY CLUB.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

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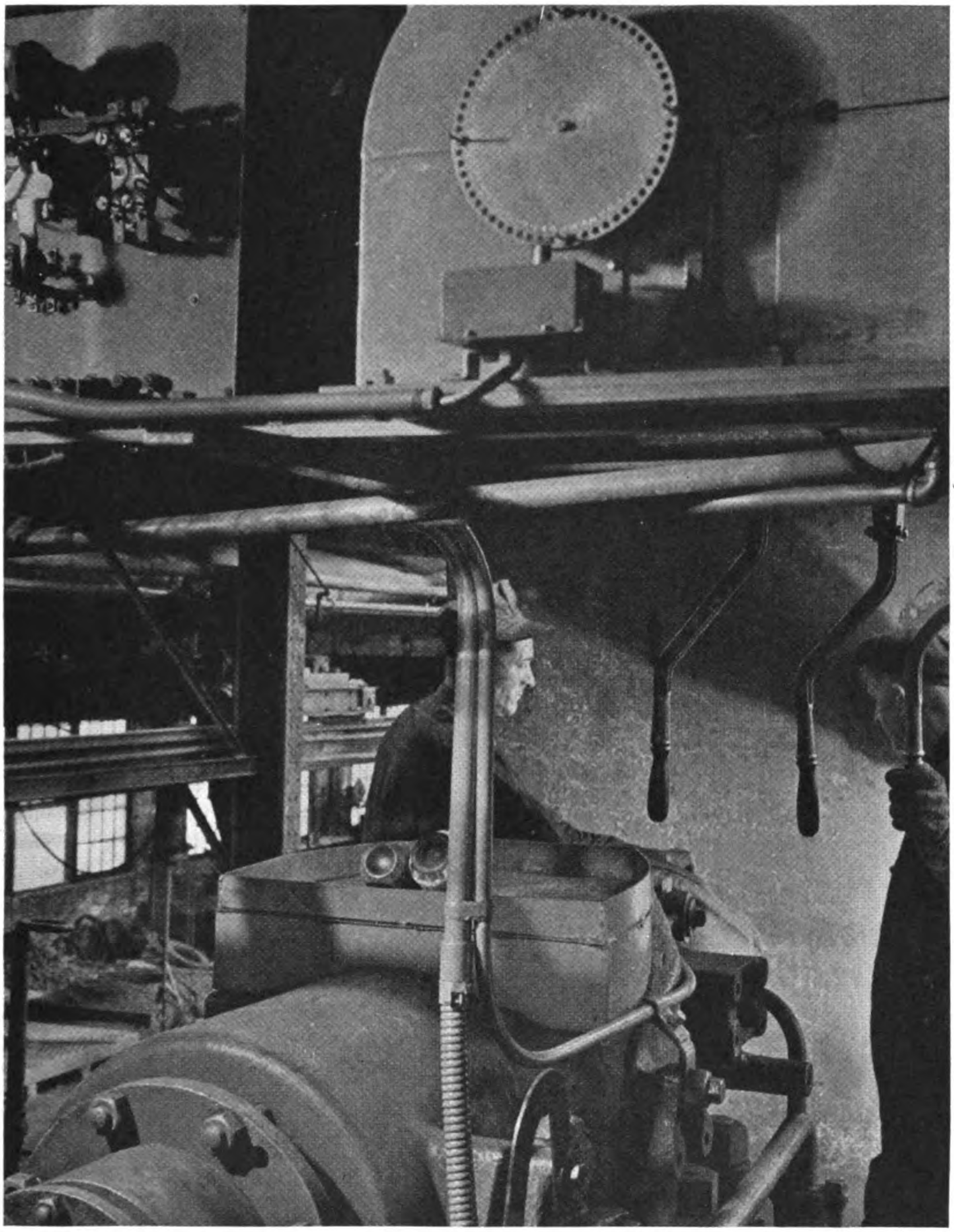
METHODS AND MACHINERY THAT GUARD LIMA QUALITY



RIVETING *is automatically controlled at Lima*

Here is a "behind-the-scenes" view of the Lima bull-riveter. » » » No guessing here as to whether the riveting pressure has done its job. » » » Controls are automatically set to provide the proper riveting time, varying with size of plate and rivet. » » » This is just one of the numerous precautions taken at Lima to safeguard quality and build low-maintenance into its product.

LIMA LOCOMOTIVE WORKS INCORPORATED

LIMA LOCOMOTIVE WORKS, INCORPORATED, LIMA, OHIO

NEWS

Cost of Injuries Going Up

SAFETY in the mechanical and maintenance-of-way departments of the railroads was the major topic of discussion at a regional safety meeting of the Safety Section of the Association of American Railroads held in conjunction with the Seventeenth Annual Midwest Safety Conference at Chicago on May 10. Among those addressing the meeting were W. T. Faricy, general solicitor of the Chicago & North Western, who spoke on Employer Financial Responsibility for Accidents to Employees; C. M. House, superintendent of motive power and equipment of the Alton, who spoke on the Mechanical Department's Responsibility in Accident Prevention; G. M. O'Rourke, district engineer of the Northern Lines of the Illinois Central, who spoke on Safety Promotional Work in Railroad Maintenance of Way and Structures; Warren E. Fuller, assistant to the vice-president, traffic department, of the Chicago, Burlington & Quincy, whose subject was Safety's Contribution Economically and Socially, and W. H. Emerson, general master car builder of the Elgin, Joliet and Eastern, who talked on Safety in the Car Department.

Mr. Faricy discussed laws governing accidents to employees, showing how, during 35 years, the common law of master and servant under which the employer's liability was narrow has developed into present laws under which, if an employee is injured or killed in the course of his employment the employer or his insurance company pays medical, surgical and hospital bills, or funeral expenses as the case may be, and a weekly allowance to the injured man during the period of his disability or to his widow and orphans up to a certain prescribed amount. As a result, he said, the prevention of an accident today means a lot more money than it did 35 years ago. In Wisconsin, for instance, he continued, where the North Western became subject to the State Workmen's Compensation Act in 1917, the weekly compensation indemnity then required by the act was $9.75. That was the maximum weekly payment required at that time for any one injury. Now the maximum has risen to $21 a week. As of that time, the maximum indemnity provided for an injured man thirty-five years of age was $7,605. At the present time, an employee of that same age, injured under the same circumstances, may recover up to a maximum of $38,220.

At present, he said, there are pending in Congress several proposals which would further amend the Federal Employers Liability Act in favor of the employee and give rights of recovery to injured persons in many cases where none exist under present law. Some of these bills have already been reported favorably by committees and, if they pass, their inevitable effect will be to increase further the amounts payable for personal injuries.

Mr. House discussed the safety movement on his railroad, which resulted in a record of no federal defects reported by Interstate Commerce Commission inspectors on locomotives so inspected for a period of two fiscal years. He emphasized the need for discipline. On the Alton, he said, when an accident occurs, whether reportable or non-reportable, the man involved is immediately called by the foreman for investigation. Unless he can show good explanation for the injury, his personal record is assessed with discipline. It is seldom, he continued, that the same employee is responsible for a second reportable accident, indicating there is profit in experience.

"Safety educational work to be successful," according to Mr. O'Rourke, "must come down from the top. The great mass of men follow leaders. They may protest against the fact, but they do it all the same, for they cannot help it, and when we pass judgment on the employee, we are obliged to inquire what kind of an example has been set him by his employer." He stressed also the effectiveness of friendly competition as a stimulus for good safety records.

Dr. Zay Jeffries Honored

DR. ZAY JEFFRIES, eminent metallurgist, has been elected to membership in the National Academy of Sciences. The election was announced at a luncheon in the Union Club in Cleveland on May 12. In congratulating Dr. Jeffries, the president of Case Institute, Dr. William E. Wickenden said: "You are inheriting the place of two world figures. As a Clevelander you are succeeding Ambrose Swasey, eminent industrialist, patron of science and doer of good works: as a scientist you are succeeding Albert Sauveur, pre-eminent in the art of metallography."

Dr. Jeffries has contributed numerous important developments in the science of metals as a result of his research with tungsten lamp filaments, high strength aluminum alloys, and the application of x-ray analysis to metallurgy. During the period from 1932 to 1936, he was president of Carboloy Company, Inc., and since that time has served as chairman.

Retirement Board Appoints Twelve Regional Directors

APPOINTMENT of regional directors for the 12 administrative regions of the Railroad Retirement Board's field operations was recently announced by the Board. The main functions of the regional offices in charge of the regional directors will be to administer the Railroad Unemployment Insurance Act which goes into effect July 1.

According to a plan of decentralized field operation, unemployment insurance claims will be received initially by designated agents of the railroads or other employers under the Act. The claims will then be sent to the regional offices for adjudication and certification for payment. The location of the regional offices, the Board's announcement said, "has been planned in co-operation with the railroads and railroad labor organizations and follows the general pattern of the rail systems of the country, particularly in relation to the location of railroad pay points and of treasury disbursing offices."

The names of the regional directors and the regions to which they are assigned are as follows:

George H. Parker, director of Region I with headquarters at Boston, Mass. This region includes all the New England states.

Alexander Fleisher, director of Region II with headquarters at New York. This region includes the states of New York; New Jersey; Pennsylvania, east of Pittsburgh; Delaware; Maryland; a small section of northeastern West Virginia; and the Cape Charles peninsula of Virginia.

Carlton Hayward, director of Region III with headquarters at Cleveland, Ohio. This region includes Pennsylvania, Pittsburgh and west; Ohio; Michigan; the eastern half of West Virginia; and northeastern and central Kentucky.

(Continued on next left-hand page)

* * *

The "William Crooks," hauling two ancient coaches, on its recent trip from St. Paul, Minn., to become a part of the exhibition, Railroads on Parade, at the New York World's Fair—The locomotive now owned by the Great Northern, was built at Paterson, N. J., in 1861

LIGHTER IN WEIGHT

EASIER TO MAINTAIN

Weight has been reduced by more than half without sacrifice of strength or efficiency in the New Franklin No. 8 Combined Lubricator and Spreader. » » » This fabricated steel unit with reversible cellar and reduced distance between the hub and perforated plate provides better hub lubrication. The improved spreader maintains driving box jaws in parallel and prevents loose crown bearings. A new type of end plate makes a tight fit to exclude dust and other foreign matter. The new cellar permits reversal of tapered grease cakes which now are renewed. This saves labor and reduces the cost of lubrication. » » » For all replacements and new locomotives specify the Franklin No. 8 Lubricator and Spreader.

REG. U.S. PAT. OFF.

When maintenance is required, a replacement part assumes importance equal to that of the device itself and should be purchased with equal care. Use only genuine Franklin repair parts in Franklin equipment.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Francis E. Fleener, director of Region IV with headquarters at Chicago. This region includes the states of Indiana; Illinois; Iowa, with the exception of the southwestern corner; southern and northeastern Wisconsin; and southeastern Kentucky.

Walter Burr, director of Region V with headquarters at Richmond, Va. This region includes the District of Columbia; Virginia, except for a small area in the southwest and the Cape Charles peninsula; southeastern West Virginia; North Carolina, with the exception of the southwestern portion; and eastern South Carolina.

Leon L. Wheeless, director of Region VI with headquarters at Atlanta, Ga. This region includes the states of Georgia; Florida; Mississippi; Alabama; Tennessee; western South Carolina; western North Carolina; extreme southwestern Virginia; and southern Kentucky.

Harris G. Pett, director of Region VII with headquarters at Minneapolis, Minn. This region includes the states of Minnesota; North Dakota; South Dakota, except for a section in the southwest; eastern Montana; and northwestern Wisconsin.

William A. Murphy, director of Region VIII with headquarters at Kansas City, Mo. This region includes the states of Missouri; Oklahoma, except the tip of the pan handle; Arkansas, except the southwestern corner; Kansas, with the exception of the extreme west; the eastern half of Nebraska; the southwestern corner of Iowa; and a small section of southern South Dakota.

W. A. Rooksbery, director of Region IX with headquarters at Dallas, Texas. This region includes the states of Louisiana; Texas; the southwest corner of Arkansas; southern and eastern New Mexico; and a small piece of southeastern Arizona.

Harry K. Sorenson, temporarily assigned as director of Region X with headquarters at Denver, Colo. This region includes the states of Colorado; Wyoming; Utah; western Nebraska; extreme western Kansas; southwestern South Dakota; southern Idaho; southeastern Oregon; northeastern Nevada; the northern half of Arizona; northern and western New Mexico; and the tip of the Oklahoma pan handle.

Shirl L. Blalock, director of Region XI with headquarters at Seattle, Washington. This region includes the states of Washington; northern Idaho; the western half of Montana; and Oregon, except for the extreme south and west.

James B. Cress, director of Region XII with headquarters at San Francisco, California. This region includes the states of California; most of Nevada; the southern segment of Oregon; southern Arizona; and a small section of southwestern New Mexico.

Research in Steel Technology

RESEARCH in steel technology formerly conducted by The Association of American Steel Manufacturers Technical Committees, with headquarters at Pittsburgh, Pa., has been transferred to the Technical Committees of American Iron and Steel Institute, according to a recent announcement by American Iron and Steel Institute and The Association of American Steel Manufacturers Technical Committees. The offices of the latter Association, which was established some 40 years ago, have been closed.

The standards for chemical compositions, physical properties, rolling tolerances and other permissible variations from specified dimensions originally promulgated by The Association of American Steel Manufacturers Technical Committees will hereafter be sponsored by American Iron and Steel Institute, and will be published as a part of its "Steel Products Manual."

C. E. Brinley Discusses Motive Power in Yale Scientific Magazine

CHARLES E. BRINLEY, president of the Baldwin Locomotive Works, is the author of an article on railroad motive power appearing in a recent "Yale Scientific Magazine." Meeting the oft-repeated criticism that the railroads are not progressive, the writer presents various operating criteria which indicate the basic improvement in railroad speeds and efficiency. In this connection Mr. Brinley notes such refinements in motive power as the application of roller bearings to axles, the use of heat-treated and alloy steels and studies in the reduction of dynamic augment.

Discussing the relative advantage of prime movers in the industry, the Baldwin president expresses the opinion that Diesel-electric is now justly pre-eminent in the switching field and has proved its efficiency to some extent in high-speed passenger service. He believes, however, that something must yet be done in making the Diesel-powered unit more flexible in load capacity and lower in cost.

As for steam locomotives he writes: "It is not unlikely that an important step forward may be found in the use of poppet valves and higher steam pressures and superheat, permitting early cutoffs with a consequent reduction in fuel and water consumption as compared with the best practice of today, and it is entirely possible that small steam units may be developed, which will successfully handle light-weight streamline trains of a few cars, showing at the same time a marked reduction in first cost and interest charges. A Diesel-electric power plant is not by any means an essential feature of a light train."

Equipment Depreciation Orders

EQUIPMENT depreciation rates for the Bevier & Southern, Lake Erie & Eastern and Wichita Northwestern are prescribed by the Interstate Commerce Commission in modifications of previous sub-orders in No. 15,100 Depreciation Charges of Steam Railroad Companies. The Bevier & Southern sub-order prescribed rates as follows: Steam locomotives, 3.01 per cent; freight-train cars, 3.33 per cent. The Lake Erie & Eastern got prescribed rates of 4.81 per cent on steam locomotives and 2.71 per cent on work equipment; while the Wichita Northwestern got 8.55 per cent for steam locomotives, 6.83 per cent for owned freight cars, 3.68 per cent for leased freight cars, 9.52 per cent for passenger-train cars, and 7.72 per cent for work equipment.

Illinois Central Purchases Locomotive Scale

THE Illinois Central has placed an order with Fairbanks Morse & Company for an eighteen-section, plate-fulcrum individual wheel weighing locomotive scale, with a total capacity of 900,000 lb., for its Paducah, Ky., shops.

No A.A.R. Appeal in Automatic Stoker Case

THE Association of American Railroads will not enter an appeal on behalf of the railroads from the recent decision of a three-judge federal court at Cleveland, Ohio, upholding the Interstate Commerce Commission's order in the automatic stoker case. This decision of the A. A. R. became known following April 28's Washington, D. C., meeting of the Association's board of directors.

New Equipment Orders and Inquiries Announced Since the Closing of the May Issue

Locomotive Orders

Road	No. of Locos.	Type of Loco.	Builder
A. T. & S. F.[1]	13	1,000-hp. Diesel-elec. switch.	Electro-Motive Corp.
	1	4,000-hp. Diesel-elec. pass.	
	12	1,000-hp. Diesel-elec. switch.	American Loco. Co.
	5	1,000-hp. Diesel-elec. switch.	Baldwin Loco Wks.
C. B. & Q.	5	600-hp. Diesel-elec. switch.	Electro-Motive Corp.
Great Northern	14	1,000-hp. Diesel-elec. switch.	Electro-Motive Corp.
K-C-S	2	2,000-hp. Diesel-elec.	Electro-Motive Corp.
Lehigh Valley	3	20,000-gal. tenders	American Loco. Co.
Pere Marquette	1	600-hp. Diesel-elec. switch.	Electro-Motive Corp.

Locomotive Inquiries

Road	No. of Locos.	Type of Loco.	Builder
A. C. & Y.	2	2-8-2	....
United Fruit Co.	5	2-8-2	....

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Birmingham Southern	100	Hopper	Pullman-Std. Car Mfg. Co.
	10	Flat	
D. & R. G. W.	400	Box	Pressed Steel Car Co.
	100	Auto-box	
	50	Gondolas	
	100	Underframes	
Ferrocarril al Pacifico	50	30-ton box	Magor Car Corp.
Maine Central	300	Gondolas	Bethlehem Steel Co.
Union Railroad	10	Caboose	Greenville Steel Car Co.
United States Navy	6	50-ton flat	Greenville Steel Car Co.

Freight-Car Inquiries

Road	No. of Cars	Type of Car	Builder
General Chemical Co.	5 or 10	50- or 70-ton hopper	....
Lehigh & New England	50 or 100	70-ton bulk cement	....
Western Maryland	500	50-ton box	....
	500	50-ton hopper	....
	100	50-ton gondola	....
	10	50-ton flat	....

Passenger-Car Inquiries

Road	No. of Cars	Type of Car	Builder
A. T. & S. F.	11	Lightweight	....
Florida East Coast	See Note[2]		....

[1] When these locomotives are delivered, the Santa Fe will have 41 Diesel-electric switching locomotives and 11 Diesel-electric passenger locomotives with an aggregate horsepower of 37,500 in switching service and 27,400 in passenger service.

[2] Plans to buy two streamline trains of seven cars each, to be hauled by Diesel-electric locomotives.

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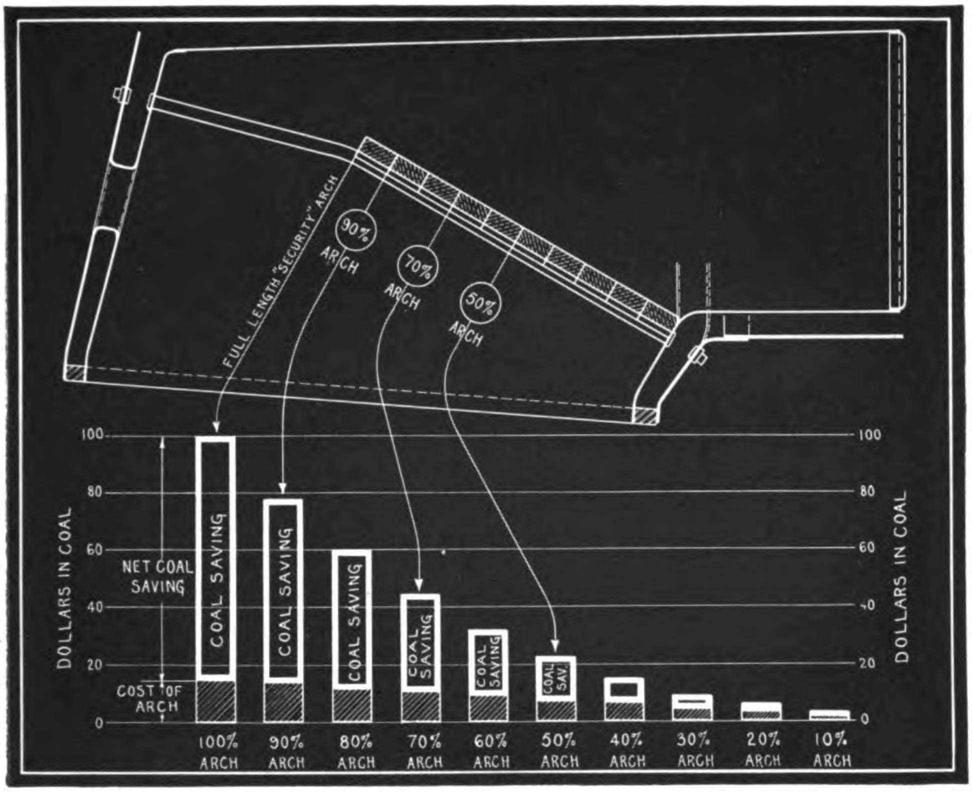

THE EFFECT OF ABBREVIATED ARCHES ON FUEL SAVING

LET THE ARCH HELP YOU SAVE

With the emphasis being placed on saving every railroad dollar, the locomotive Arch becomes increasingly important.

Regardless of the amount of traffic handled, the locomotive Arch saves enough fuel to pay for itself ten times over.

Be sure that every locomotive leaving the roundhouse has its Arch complete with not a single brick nor a single course missing.

In this way, you will get more work for each dollar of fuel expense. Skimping on Arch Brick results in a net loss to the railroad.

THERE'S MORE TO SECURITY ARCHES THAN JUST BRICK

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.

Locomotive Combustion Specialists

Supply Trade Notes

Marvin W. Smith, has been elected a vice-president of the Westinghouse Electric & Manufacturing Co., with headquarters at Pittsburgh, Pa.

◆

Gordon F. Hess, assistant manager of sales of the Alloy Steel division of the Republic Steel Corporation, Massillon, Ohio, has been appointed sales manager at Houston, Tex.

◆

T. E. Barlow has been appointed metallurgical engineer of the Copper Iron & Steel Development Association with headquarters at Cleveland, Ohio.

◆

Howard G. Hill has resigned as mechanical engineer of the Miller Felpax Company, Winona, Minn., to engage in other business.

◆

The Symington-Gould Corporation, New York, has been appointed to handle the national sales and installation of the Felpax lubricator of the Miller Felpax Company, Winona, Minn.

◆

W. Purdue, consulting engineer of the Ramapo Ajax division of the American Brake Shoe & Foundry Company, Chicago, retired on May 1, but continues in an advisory capacity.

◆

The Independent Pneumatic Tool Company, Chicago, has opened a branch office at 1544 Broadway, Denver, Colo., with C. A. Turnquist in charge.

◆

Joseph T. Ryerson & Son, Inc., Chicago, has reconstructed its plant at Cambridge, Mass., to increase the ground area occupied more than 30 per cent, and storage facilities to a greater extent.

◆

J. J. Alves, Jr., northeastern regional representative of the Railroad division of the Worthington Pump & Machinery Corp., Harrison, N. J., has taken over also the southeastern region, W. M. Vinnedge, formerly southeastern regional representative having resigned.

◆

Edwin J. Schwanhausser, works manager at the Buffalo, N. Y., plant of the Worthington Pump & Machinery Corporation, Harrison, N. J., has been elected a vice-president. Mr. Schwanhausser, as vice-president and works manager, will continue in his present responsibilities.

◆

W. Robert Timken has been appointed assistant to the president of The Timken Roller Bearing Company, Canton, Ohio. Since graduating from Harvard University in 1933, he has been active in the office and factory, serving in various capacities throughout the plant. He will continue his headquarters in the general office at Canton.

◆

The Whiting Corporation, Harvey, Ill., has moved its Chicago district sales office from the Franklin-Adams building to the Fisher Building at 343 South Dearborn Street.

◆

C. B. Robinson, general manager of the J. B. Ford Sales Company, Wyandotte, Mich., who has been connected with this company for 22 years has been elected president and W. F. Torrey, who has been connected with the company for six years, has been elected secretary-treasurer; both will serve on the board of directors.

◆

A. D. Sheere, assistant division manager at Atlanta, Ga., of the A. M. Byers Company, Pittsburgh, Pa., has been appointed manager of the Houston, Texas, division office. W. B. Simpson, sales representative in the Pittsburgh division's northern territory, has been appointed assistant division manager, Atlanta, to succeed Mr. Sheere.

◆

Roy C. Munro, who for the past 14 years has been western sales manager of the Waugh Equipment Company, New York, has been elected vice-president, with office as heretofore at 310 South Michigan avenue, Chicago. Mr. Munro was born in 1884 at Annapolis Royal, Nova Scotia, Canada. In 1905 he moved to Chicago and attended the Armour Institute of Technology. After serving for

Roy C. Munro

several years in the mechanical department of the Pullman Company, Canadian Car & Foundry Co., and the Atchison, Topeka & Santa Fe, he went with the Union and Southern Pacific System as mechanical assistant in the purchasing department. In 1912, he was appointed a sales representative for the Acme Supply Company, Chicago. Five years later he became associated with the Chicago-Cleveland Car Roofing Company as sales representative and, when this organization was sold, he became connected with the Waugh Equipment Company as sales representative. In 1928 he was appointed western sales manager.

George W. Sines, mechanical engineer of the Western-Austin Company, Aurora, Ill., has resigned to become affiliated with the Symington-Gould Corporation, Rochester, N. Y.

◆

J. E. Buckingham, formerly vice-president of the Lincoln Electric Railway Sales Company, has been elected vice-president in charge of all railway sales for the Portable Plating & Equipment Company, Chicago.

◆

C. N. Kirkpatrick has been elected a vice-president of the Landis Machine Company, Waynesboro, Pa. Mr. Kirkpatrick continues also as secretary of the company. G. M. Stickell, assistant sales manager has been appointed sales manager.

◆

W. M. Nones has been elected chairman of the board of the Norma-Hoffmann Bearings Corporation, Stanford, Conn. O. P. Wilson has been elected president and treasurer; H. J. Ritter, vice-president and secretary, and C. B. Malone, vice-president in charge of plant operations.

◆

C. H. Kuthe has been appointed technical adviser to the Michigan division of Revere Copper & Brass, Inc., Detroit, Mich. Mr. Kuthe previously served in a sales and sales engineering capacity for the Timken Roller Bearing Company in the Philadelphia, Pa., district.

◆

Willard H. Cobb, general factory manager, mechanical goods plants, United States Rubber Company, has been appointed general manager of the mechanical goods and general products division, including supervision of the manufacture of Lastex, yarn and rubber thread, with headquarters at New York.

◆

The International Nickel Company has opened a new field office at 67 Wall street, New York, under the direction of J. W. Sands, whose duties will be to promote the use of nickel alloy steels and stimulate interest in the company's products.

◆

H. W. Wolff, assistant director of purchases for the Westinghouse Air Brake Company and subsidiaries, including the Union Switch & Signal Co., has been promoted to director of purchases with headquarters, as formerly, at Wilmerding, Pa. He succeeds W. A. Forrester, who has retired after 49 years of continuous service with the Westinghouse Air Brake Company. Mr. Wolff was born near Elizabeth, N. J., and after being graduated from the local high school and business college, entered the employ of the Hall Switch & Signal Co., at Garwood, N. J. In a few years he rose to the position of purchasing agent, and thereafter successively held the positions of works manager, general man-

ager and treasurer, and was a member of the board of directors. After the Hall Company was absorbed by the Union Switch & Signal Co., in 1925, Mr. Wolff served the latter company in a general executive capacity. In 1937 he became assistant director of purchases of the Air Brake Company.

MELVIN PATTISON, president and treasurer of the Industrial Brownhoist Corporation, Bay City, Mich., has been elected chairman of the board, and has been succeeded by Hoyt E. Hayes, vice-president. James B. Hayden, assistant sales manager, has been promoted to sales manager.

R. S. WHARTON, general sales manager of the Quaker City Rubber Company, Philadelphia, Pa., has been promoted to vice-president in charge of sales to succeed F. C. Millhoff, who has retired. Mr. Wharton's headquarters are at Philadelphia. G. C. Johnson, manager of the Chicago branch, has been promoted to general sales manager, with headquarters at Philadelphia, and H. C. Heine, has been promoted to manager of the Chicago branch, with E. Asbridge as assistant.

THE UNITED STATES STEEL CORPORATION of Delaware will open an executive office in Chicago, according to an announcement made by Benjamin F. Fairless, president, at a luncheon at the Blackstone Hotel on April 26. G. Cook Kimball, executive vice-president of the Carnegie-Illinois Steel Corporation, has been elected executive vice-president of the United States Steel Corporation at Chicago.

WILLIAM J. KELLY, for many years traffic manager of The Baldwin Locomotive Works and subsidiary companies at Philadelphia, Pa., and Eddystone, has been promoted to the newly created position of manager of industrial relations. Craig Johnston, who has been on Mr. Kelly's staff in the traffic department for the past 20 years, has been appointed acting traffic manager.

FOSTER E. WORTLEY, manager of The American Rolling Mill Company's Cleveland, Ohio, district sales office, has been appointed assistant manager of the midwestern sales area, with headquarters at Middletown, Ohio. Henry L. Woods, Jr., who has been attached to the Armco sales office at Detroit, Mich., as a salesman for the past 10 years, has been appointed manager of the Cleveland office to succeed Mr. Wortley.

Obituary

CHARLES NEHER, district sales manager of Templeton, Kenly & Co., Chicago, with headquarters at Dallas, Tex., died in that city on April 5.

EARL L. COLOPY, sales representative in the eastern region of the Transportation Department of Johns-Manville Sales Corporation, New York, died at Jersey City Medical Center, Jersey City, N. J., on May 17, after a brief illness. Mr. Colopy was born at Lockport, N. Y., November 22, 1887, and entered the service of Johns-Manville in 1908 as a stenographer and since 1918, had served as a sales representative.

Personal Mention

General

W. D. QUARLES has been appointed general mechanical instructor of the Atlantic Coast Line, with system jurisdiction, at Rocky Mount, N. C.

EDWIN F. RICHARDSON, assistant engineer motive power of the Bessemer & Lake Erie, has been appointed assistant superintendent motive power, with headquarters as before at Greenville, Pa.

H. C. WYATT, assistant master mechanic of the Radford-Shenandoah divisions of the Norfolk & Western, has been appointed superintendent of the Shenandoah division with headquarters at Roanoke, Va.

EDWARD E. ROOT, master mechanic of the Morris and Essex division of the Delaware, Lackawanna & Western, with headquarters at Hoboken, N. J., has been appointed assistant chief of motive power, with headquarters at Scranton, Pa.

Master Mechanics and Road Foremen

L. E. LONERGAN, assistant master mechanic on the Southern Pacific at Roseville, Calif., has been appointed master mechanic of the Sacramento division, with headquarters at Sacramento, Calif., succeeding H. J. McCracken, deceased.

F. E. RUSSELL, JR., foreman of machinists of the Southern Pacific at Roseville, Calif., has been appointed assistant master mechanic at that point.

LELAND T. FIFE, master mechanic of the San Joaquin division of the Southern Pacific at Bakersfield, Calif., has been transferred to the Coast division, with headquarters at Bayshore, Calif. Mr. Fife was born on July 29, 1887, at Ogden, Utah, and received his education in the public schools of Ogden and through a correspondence-school course. He entered the employ of the Southern Pacific in July, 1905, serving as an engine wiper, a machinist helper, and an electric craneman until July 1, 1907. For the next four years he was a machinist apprentice at Ogden. From January, 1912, to September, 1912, he was a machinist and night foreman for the Utah Copper Company at Arthur, Utah; from October, 1912, to March, 1913, a machinist on the Chicago, Milwaukee & St. Paul; from October, 1913, to May, 1914, machine shop foreman, Bingham Garfield Railroad and Utah Copper Company, Magna, Utah, and from July, 1919, to November, 1919, a machinist on the Union Pacific at Provo, Utah, and North Platte, Neb. From December, 1920, until his recent appointment, he has been in the service of the Southern Pacific successively as a machinist, erecting foreman, department foreman, general foreman, assistant master mechanic of the Portland division, and master mechanic of the San Joaquin division. Mr. Fife was appointed to the latter position on August 1, 1937.

L. T. Fife

FREDERICK T. H. JAMES, general foreman of the Kingsland locomotive shops of the Delaware, Lackawanna & Western at Kingsland, N. J., has been promoted to the position of master mechanic at Hoboken, N. J., succeeding E. E. Root.

EDWIN E. HINCHMAN, who has been appointed master mechanic of the San Joaquin division of the Southern Pacific at Bakersfield, Calif., as noted in the April issue, was born on February 17, 1894, at San Francisco, Calif. He attended public schools, and from September 3, 1912, to April 30, 1926, was a draftsman in the motive-power department, general office, of the Southern Pacific. From May 1, 1926, to June 15, 1936, he was dynamometer engineer on locomotive efficiency tests—about five years on road tests, and in the general office at 65 Market street, San Francisco, on various duties in the

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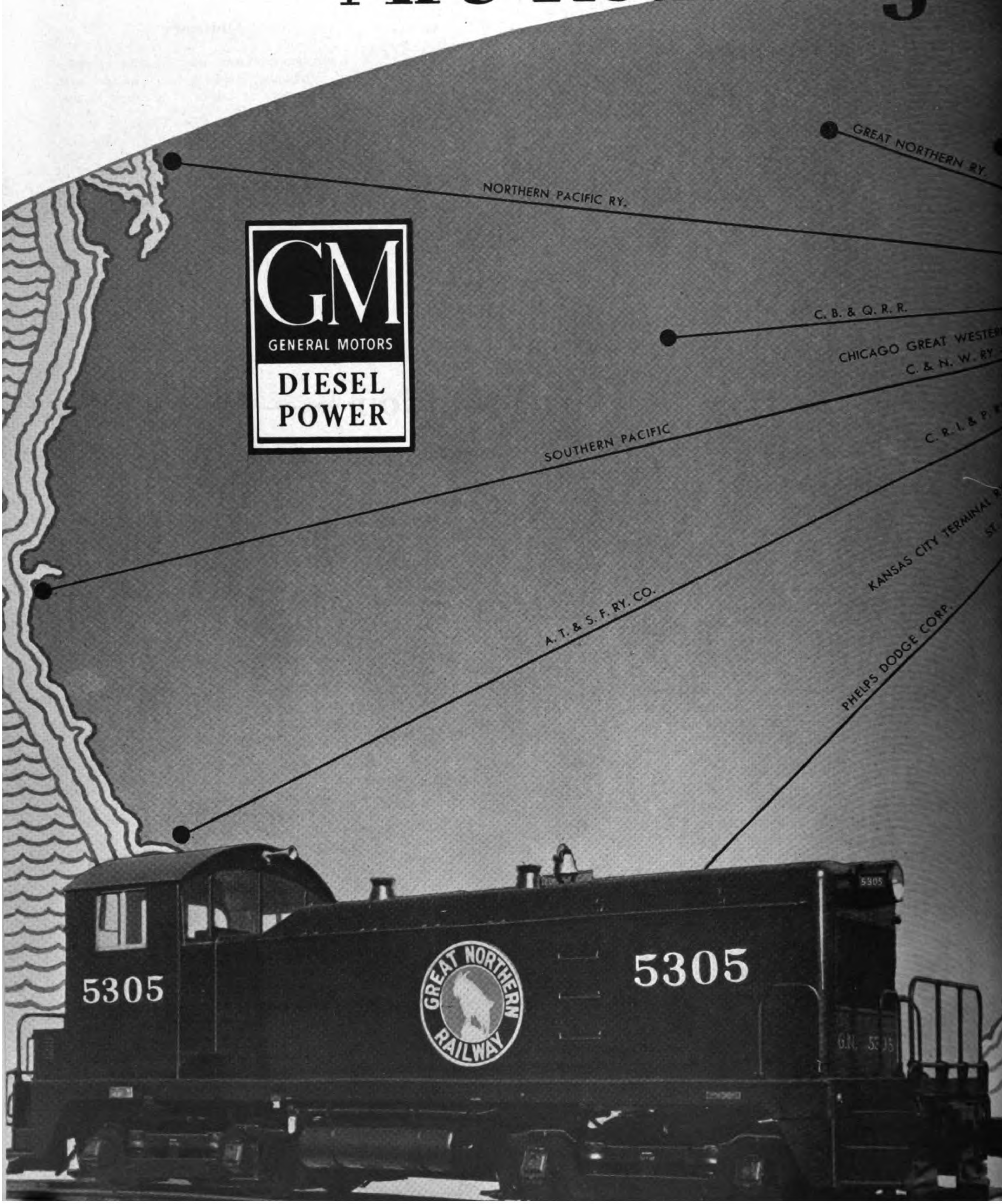
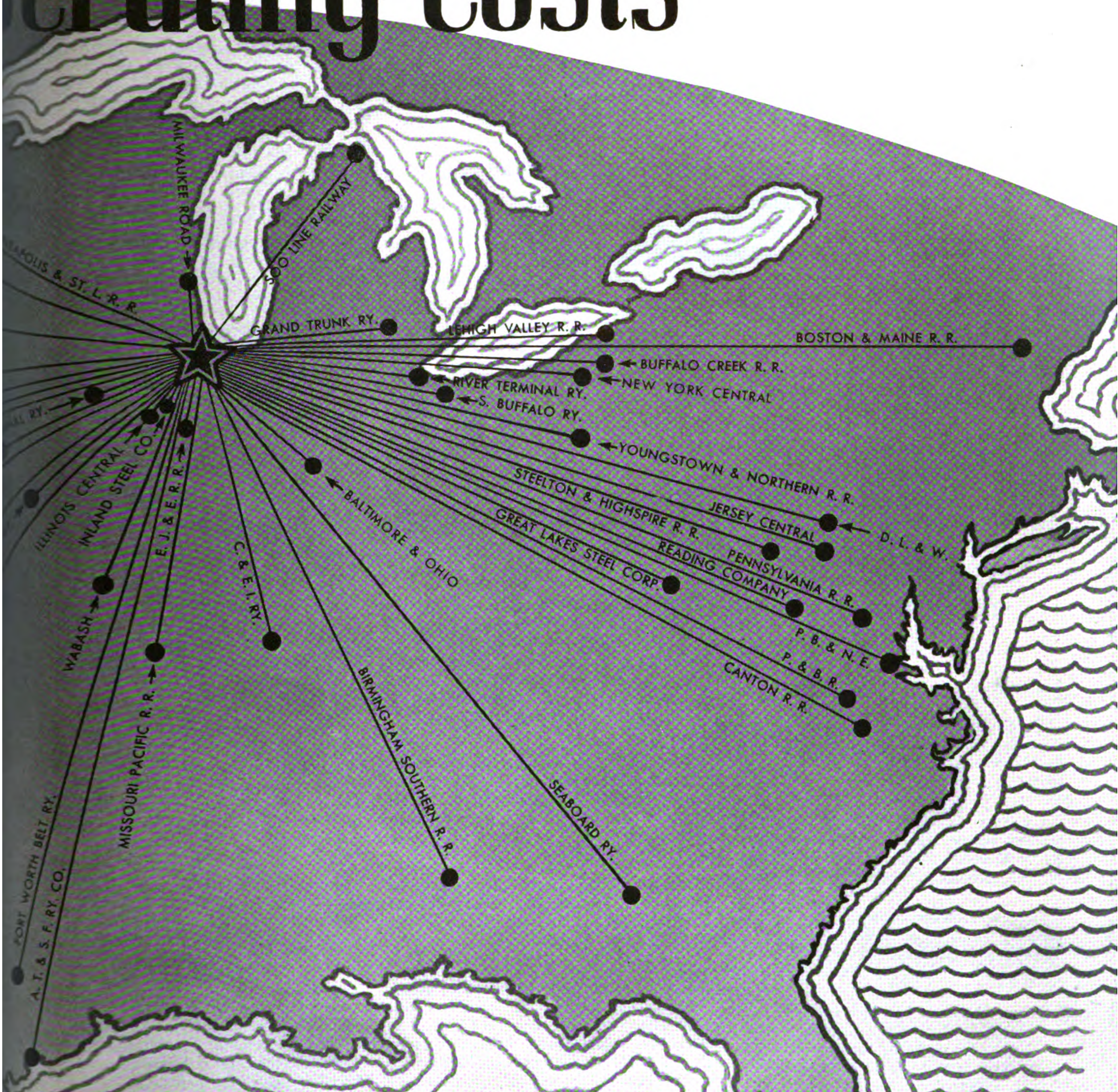
From Coast to Coast
Are Reducing C



EMC Diesel Switchers
...erating Costs



SERVICE records covering well over a million hours of operation prove conclusively that Electro-Motive Switchers have reduced locomotive costs from 50 to 75 per cent—provide faster, smoother, safer car movements and deliver most work per dollar of operating expense. That's why EMC Diesels are by far the most profitable motive power investment.

ELECTRO-MOTIVE CORPORATION

SUBSIDIARY OF GENERAL MOTORS LA GRANGE, ILLINOIS, U. S. A.

motive-power department. He was promoted to the position of assistant master mechanic at Roseville, Calif., on June 16, 1936. He was transferred to West Oakland, Calif., on October 1, 1938, and became master mechanic at Bakersfield on April 1, 1939.

C. E. Pond, general foreman foundries, Roanoke, Va., shops of the Norfolk & Western, has been appointed assistant master mechanic, succeeding H. C. Wyatt.

Car Department

O. A. Wallace has been appointed general car foreman of the Atlantic Coast Line, with headquarters at Wilmington, N. C.

W. R. Smith, leading hand-car foreman of the Canadian National at Nutana, Sask., has been appointed acting car foreman at Watrous, Sask.

A. M. McLennan, car foreman of the Canadian National at Watrous, Sask., has been appointed coach foreman at Saskatoon, Sask.

S. J. Fuller, mechanical draftsman on the St. Louis Southwestern at Pine Bluff, Ark., has been promoted to the position of general car foreman, with headquarters at Pine Bluff, succeeding George S. Beaumont, deceased.

Shop and Enginehouse

J. L. Bartle, boiler foreman of the Canadian National at Prince Albert, Sask., has retired.

E. S. Thompson, boilermaker of the Canadian National at Kamloops Jct., B. C., has become boiler foreman at Prince Albert, Sask.

Charles A. Marshall has been appointed acting night locomotive foreman of the Canadian National at Point Tupper, N. S., succeeding Stephen J. McDonald.

George Howard, apprentice class instructor of the Canadian National at Transcona, Man., has been appointed supervisor of apprentices, Western Region.

Ernest Leaman has been appointed acting assistant foreman, paint department, motive power shops, of the Canadian National, at Moncton, N. B., succeeding Wm. Carter, deceased.

L. F. Bradley, laboratory engineer in the test department of the Erie at Meadville, Pa., has been promoted to the position of general foreman, at Jamestown, N. Y.

G. L. Fisher, general foreman of the Erie at Jamestown, N. Y., has been promoted to the position of general foreman at Binghamton, N. Y., succeeding J. P. Moffitt, deceased.

L. A. Hartley, machinist leader of the Erie at Hornell, N. Y., has been promoted to the position of general locomotive inspector, district master mechanic's staff, at Meadville, Pa., succeeding H. E. Durtsche, retired.

Joseph B. Carroll, foreman of the electrical shop of the Delaware, Lackawanna & Western at Kingsland, N. J., has been promoted to general foreman of the Kingsland locomotive shop, succeeding F. T. H. James.

Purchasing and Stores

C. I. Caswell has been appointed division storekeeper of the Saratoga and Champlain divisions of the Delaware & Hudson, with headquarters at Colonie, N. Y., succeeding M. W. Farrell, deceased.

Walter R. Owen, assistant purchasing agent of the Chicago, Rock Island & Pacific at Chicago, has been promoted to purchasing agent, with the same headquarters, succeeding Frank D. Reed, deceased.

Obituary

W. A. Cotton, mechanical assistant of the Erie, with headquarters at Cleveland, Ohio, died on May 2.

George S. Beaumont, general car foreman of the St. Louis Southwestern, with headquarters at Pine Bluff, Ark., died at that point of April 17.

H. J. McCracken, master mechanic of the Sacramento division of the Southern Pacific, with headquarters at Sacramento, Cal., died at that point on April 16.

Frank D. Reed, purchasing agent of the Chicago, Rock Island & Pacific, with headquarters at Chicago, died at his home in that city on April 23, after a long illness.

Arthur L. Tucker, who retired in 1926 as assistant general storekeeper on the Chicago & North Western, with headquarters at Chicago, died suddenly of a heart attack on April 17, at Cocoa Beach, Fla.

John J. O'Brien, who retired on July 1, 1937, as superintendent of the car department of the Terminal Railroad Association of St. Louis, died on May 5 at the Missouri Pacific hospital in St. Louis, Mo.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Safety Shoes.—Lehigh Safety Shoe Co., Allentown, Pa. Stock catalog containing technical information and illustrations of steel-toe safety work shoes for various industries.

◆

Retrol.—Filtrol Corporation, 315 West Fifth street, Los Angeles, Calif. 16-page booklet, in colors, "Retrol and Its Use in the Re-refining of Used Oils."

◆

Hanna Stoker.—The Hanna Stoker Co., Cincinnati, Ohio. "The Hand that Holds the Profits Writes the Checks," an attractive, spiral-bound booklet descriptive of the Hanna stoker, with illustrations of its installation and of equipment on which it is installed.

◆

Flexible Metal Tubing.—The American Brass Company, American Metal Hose Branch, Waterbury, Conn. Bulletin SS-25. Discusses use of seamless flexible metal tubing for conveying steam, liquids, gases; control of vibration, the connecting of misaligned and moving parts, etc. Engineering data; specifications; installation rules.

Dual Wheels.—Budd Wheel Company, Detroit, Mich. Thirty-six page catalog, B39-2. Construction and application of Budd single and dual wheels, their servicing and replacement.

◆

Materials - Handling Equipment.—Lewis-Shepard Sales Corporation, 286 Walnut street, Watertown (Boston), Mass. An illustrated folder descriptive of Lewis-Shepard line of materials handling equipment and the new Celoron wheels for floor protection.

◆

Scully Stock List and Reference Book, 1939.—Scully Steel Products Company, 1319 Wabansia avenue, Chicago. A spiral-bound, thumb-indexed book for convenience in ordering material.

◆

Car Pullers, Hoists and Winches.—Stephens-Adamson Mfg. Co., Aurora, Ill. Eight page catalog. Specifications, dimensions and engineering information on how to select proper car puller.

◆

The Story of Air Conditioning.—Air Conditioning Manufacturers' Association, Southern Building, Washington, D. C. Twelve-page booklet illustrated in Disney cartoon style. Graphically describes four hypothetical characters personifying temperature, humidity, cleanliness, and air motion, the elements to be controlled in air conditioning.

RAILWAY MECHANICAL ENGINEER

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office.

A complete report of the Proceedings of the seventeenth annual meeting of the Mechanical Division begins on page 255. It covers Diesel Locomotive Operation, Development of the Steam Locomotive, Proposed Characteristics of a Passenger Car, Draft Gear, and an Economic Study of Freight-Car Construction Types

Published on the second day of each month by

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July, 1939

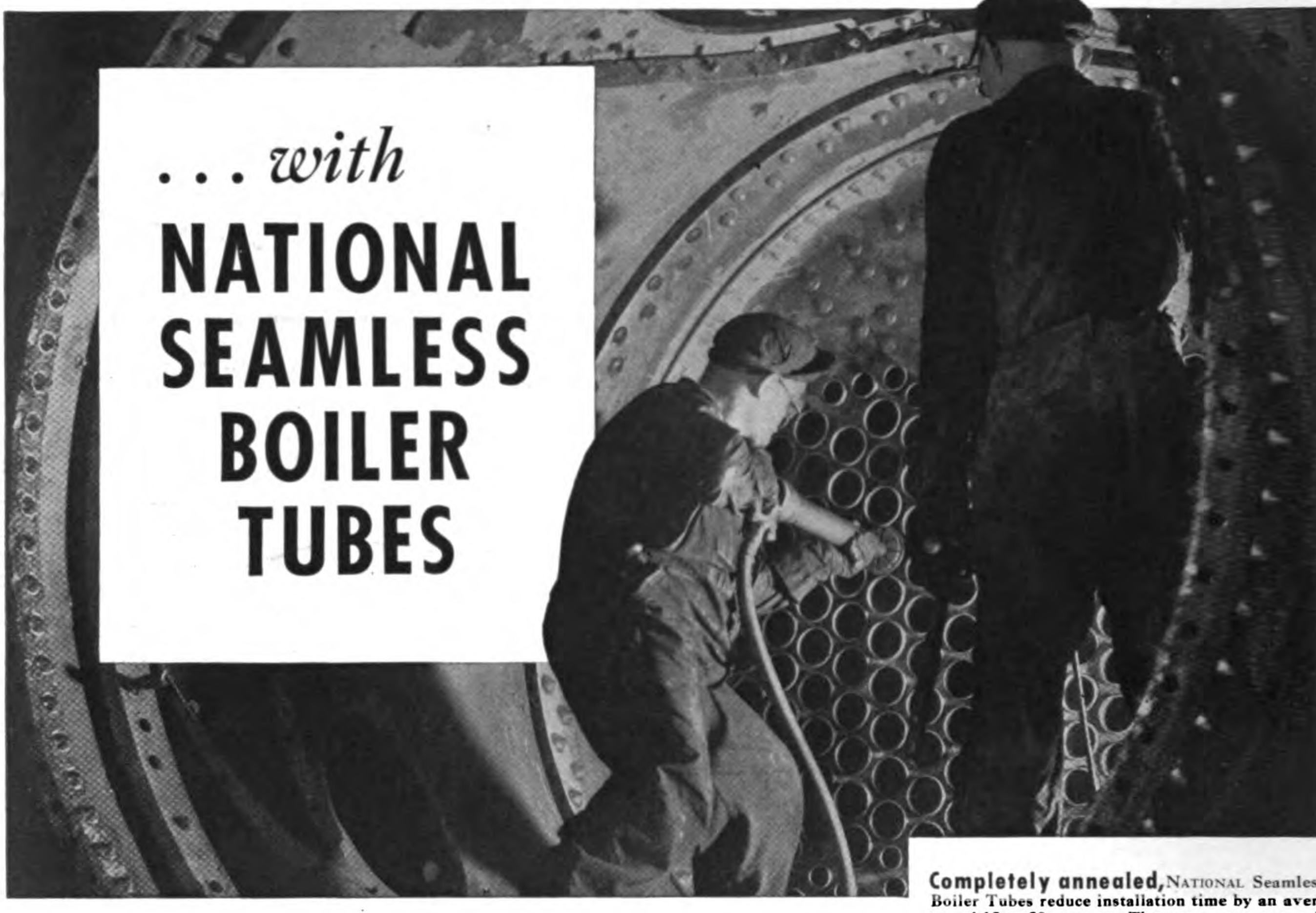
Volume 113 *No. 7*

Mechanical Division Reports:

General:

Editorials:

Here's where you Save Money



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UNITED STATES STEEL

RAILWAY MECHANICAL ENGINEER

Over 300 Attend

Mechanical Division Meeting

F. W. Hankins, Chairman

Program included reports on steam-locomotive development and Diesel locomotive operation — Study of freight-car trucks for higher speed service being pushed

W. H. Flynn, Vice-Chairman

V. R. Hawthorne
Secretary

W. I. Cantley
Mechanical Engineer

THE Mechanical Division of the Association of American Railroads held its seventeenth annual meeting at the Hotel Commodore, New York, on June 28, 29, and 30, with an attendance of over 300. Sessions were held during the morning of each day, with the afternoons free so that the members were afforded an opportunity to visit the transportation exhibits at the New York World's Fair.

During the meeting addresses were delivered by the division chairman, F. W. Hankins, chief of motive power, Pennsylvania, and by Samuel O. Dunn, chairman of the board of the Simmons-Boardman Publishing Corporation and editor of the Railway Age. W. J. Patterson, director, Bureau of Safety, Interstate Commerce Commission, and J. B. Brown, assistant chief, Bureau of Locomotive Inspection, Interstate Commerce Commission, also spoke briefly during the meeting.

Mr. Patterson raised a question as to the necessity of operating trains at speeds as high as 100 m. p. h. and said that, if such speeds are to be run, devices will have to be produced that will stop trains as efficiently in the 60- to 100-m. p. h. zone as they can now be stopped at speeds below 60 m. p. h. He drew attention to the fact that the hazard of high-speed operation has been increasing for several years and "we don't want it to continue if we can help it." In concluding his remarks, Mr. Patterson emphasized the necessity of providing better means of making emergency stops from within the train and of communicating with enginemen in emergencies. In this latter connection he mentioned the possible use of electrical communication equipment.

Mr. Brown, in the course of his remarks, directed attention to the fact that the Bureau is receiving constant complaints of hard-riding locomotives and asked that

attention be directed to this problem by members of the Mechanical Division. Chairman Hankins replied that this matter is now under consideration.

The program included 13 committee reports and an individual paper on the operation of Diesel-electric locomotives, by H. H. Urbach, mechanical assistant to executive vice-president, Chicago, Burlington & Quincy. In addition to those abstracted here, a report was presented by the Joint Committee on Utilization of Locomotives and Conservation of Fuel which presented statistical studies of locomotive and train operation during 1937 and 1938, compared with a selected list of preceding years. The General Committee also presented its formal report of events and actions since the last annual meeting which was held at Atlantic City, N. J., in June, 1937.

Election of Members of General Committee

Following the presentation of their names by the Nominating Committee the following were elected members of the General Committee to serve until June, 1941: H. B. Bowen, chief of motive power and rolling stock, Canadian Pacific; H. H. Urbach, mechanical assistant to executive vice-president, Chicago, Burlington & Quincy; G. McCormick, general superintendent motive power, Southern Pacific, and Otto Jabelman, vice-president, research, Union Pacific. G. C. Christie, general superintendent equipment, Illinois Central, was elected to serve for the unexpired term of F. R. Mays, general manager, Illinois Central, resigned, which expires in June, 1940.

Chairman Hankins' Address

Chairman Hankins, in opening the convention, reviewed recent developments in the mechanical department and important aspects of the work of the Mechanical Division. He stressed the following facts.

The two years that have just passed have been lean ones in so far as concerns railroad revenues. Nevertheless, we have witnessed very definite progress in the development and use of improved railroad equipment and in methods of operation. Even in face of discouraging business conditions the railroads have made distinct advance in motive power and rolling stock and in equipment maintenance practices.

The arch-bar truck, a very bothersome problem for a number of years, practically has been eliminated, and its use in interchange service is prohibited after December 31, 1939.

New and attractive types of passenger equipment cars have been built and placed in service, operating on faster schedules. New and improved freight equipment cars have been designed and built. Many thousands of existing freight cars have been modernized and rebuilt, and considerable progress has been made in the application of improved air brakes to freight equipment cars.

Present demands of our patrons have resulted in speeding up the schedules both of passenger and freight trains. This has introduced additional problems relating to design and maintenance of equipment, for example, the arranged freight-train service. The present faster schedules are only a forerunner of what is necessary in the quickening of deliveries in order to retain traffic on the rails. To insure reliability of this faster service, the cars must be maintained in such condition that failure of details will not occur en route.

All these problems that face us require not only special study, but also prompt solution, and involve our meeting the situation courageously and without unnecessary delay.

Since the last meeting of this division, the office of mechanical engineer has been created, and W. I. Cantley selected by the General Committee to fill it. He has been given a number of assignments and cooperates with all standing committees of the division. This has resulted in expediting consideration of important matters and will be developed further by the General Committee.

The purpose of the General Committee is not to build up a huge organization, but rather to have an efficient nucleus around which special machinery can be set up as required to handle important matters efficiently and with dispatch. The watch-word of your organization continues to be "Get things done."

At present we have before us the subject of development of trucks for high-speed freight service. The board of directors of the association has approved conducting road tests of trucks designed for this service. These road tests will be carried out to conclusion as early as practicable under direction of the mechanical engineer of the division and a special committee representing the Committee on Car Construction, the Committee on Brakes and Brake Equipment, and the Committee on Wheels.

A special committee has been appointed to survey the subject of counter-balancing of steam locomotives for high-speed service and to recommend whether or not tests should be conducted by the division.

Two years ago the General Committee recommended a research program on axles. This has been carried forward with expedition, starting with passenger-car axles, and to date three reports of progress have been submitted to the members so that they may be informed fully as to what is being accomplished. It is expected as a result of this research that modified design for passenger-car axles will be developed shortly.

The various standing and special committees of the division are entitled to credit and our thanks for the manner in which they have handled their assignments. With the reduction that has obtained generally in staff officers of the mechanical department—below what would have been considered a minimum several years ago—the members of your committees have discharged ably their duties in the work of the association, notwithstanding the additional work handled on the home road.

Among the outstanding achievements of the past year has been the development and adoption as recommended practice of specifications for new passenger-equipment cars. It was a fine example of prompt and efficient solution of a problem.

Address by Samuel O. Dunn

Samuel O. Dunn, editor Railway Age, was the guest speaker. An abstract of his talk follows: All the great technological progress made in this country within the last twenty years has done no good, because the contribution it should have made to the public welfare has been prevented by government, business and labor with the most ignorant, stupid, and ruinous economic policies ever suffered by a great nation.

A nation's total income is the measure of its well-being. It is usually stated in money, but it actually consists of the goods produced. The trends of our national income before and since the war present a shocking contrast.

We had recovered in 1896 from the panic of 1893. Allowing for differences in prices, and stated in volume of goods actually produced, our national income increased 82 per cent in the twenty years from 1896 to 1916—just before we entered the war—and our income per capita increased 30 per cent. During the next twenty years,

from 1916 to 1936, when undoubtedly there was equal technological progress, our national income (measured in production) increased only 17 per cent and our income per capita actually declined 8 per cent. In 1938 our income per capita was actually as small as thirty-three years before in 1905.

We have heard it claimed that unemployment, and even all the ills of depression, within the last decade have been caused by technological progress amounting to a revolution. There has been a revolution all right, but no more of a technological one than before, because the increase of production from 1896 to 1916 shows there was at least as much progress in technology then as since. The revolution we really have had since 1916, and especially since the war, has been an economic one.

Before the war we had both technological and economic progress. We have since had only technological progress. There is much talk implying they are the same thing; but they are widely different things. If a factory employing a hundred men increases its output 50 per cent per man by improving its machinery, that is technological progress. If it also increases its production and sales 50 per cent, that is economic progress. But if it does not increase its production and sales and consequently throws one-third of its employees out of work, there is economic retrogression. And that is actually the way in which, during the last two decades, we have simultaneously made technical progress and economic retrogression in this country.

You and other technical men have done your work splendidly. In spite of all the aspersions regarding lack of research and so on, engineering work of every kind has been as well done on the railroads as in any other American industry. It made it possible during the twenty years before the war for the railways to double the amount of traffic they handled per dollar of investment, per employee, per locomotive, and per car. The lack since the war of such economic progress as occurred before has been due entirely to unsound economic policies followed by business, political, and labor leaders.

Technical men have worked in accordance with physical laws. Business, political, and labor leaders have nullified all that technical men have done by trying to disregard or override economic laws. All human experience has shown it can't be done—and never so conclusively as in the United States during the last decade. Unsound economic policies have ruined many more great nations than war. Whenever they unearth the ruins of a great nation anywhere, you may depend on it that it was ruined more by its unsound economic policies than by its enemies; because sound economic policies are as necessary in war as sound military policies, while unsound economic policies are about equally ruinous in either peace or war.

Great Britain suffered vastly more from the great war than this country; but, as compared with the period before the war, Great Britain is now relatively much more prosperous than the United States. Why? Because during the depression Great Britain's business, its labor, and its government have followed the economic policies that pulled both Great Britain and the United States out of all previous industrial depressions, while we have followed entirely different policies. Hence, our economic revolution—backward.

Who started this economic revolution? Business—and it has since been ably assisted by politicians and labor leaders. Business started it when, before the war, in addition to railway regulation to stop unfair discriminations, it got regulation to curtail railway profits. Business continued it when it got our federal and state governments spending billions of dollars a year on waterways and highways to subsidize competition with the railways and thereby more effectively beat down their rates and profits. Our transportation situation, and especially our railway situation, has been among the principal causes of the depression and its long continuance.

We have had in this country what is called a system of "free private enterprise." In order to increase the national income as it did before the war, this system must operate in accordance with its own economic laws, the principal of which is supply and demand. From the depression of the nineties to the Great War most prices and wages were fairly flexible and were determined principally by supply and demand. But business began back there monkeying with prices (including railway rates) regardless of supply and demand.

These, in brief, are the causes of the economic revolution which has stopped our economic progress. They are the causes of the present railway situation because they have curtailed total production and traffic, diverted traffic from the railways to other carriers, and increased their operating expenses and taxes, with the result that their net earnings in 1938 were actually smaller than forty years before, in 1898.

Within the last week President Roosevelt has proposed, in addition to its present huge expenditures, that the federal government shall make about four billion dollars in "self-liquidating" loans to stimulate business, including a half billion dollars for buying equipment during the next three years to be leased or sold to the railroads. Their net earnings always have determined how much equipment and materials the railroads have bought, and I am unable to see how, without an increase in their net earnings, they could lease or buy any equipment from the government that they could not lease or buy direct from the manufacturers, while, if their net earnings did increase, they could and would increase their buying direct from manufacturers proportionately.

Their purchases of equipment and materials in 1938 alone were 972 million dollars less than in 1929, and in the last seven years they averaged 787 million dollars annually less than in the seven years ended with 1929. The proposed "government aid" would be mere chicken feed compared with the curtailment of railroad buying caused, and still being caused, by policies making net earnings less now than they were 40 years ago, and this entire new "self-liquidating" loan plan undoubtedly, in view of our experience with similar government policies for the last six years, would retard, rather than stimulate, business recovery and railroad earnings.

What shall we do about it all? First, no effort should be spared to continue technical progress in the railroad, as well as other industries, by the adoption of every improvement possible in equipment, materials and methods. Second, no reasonable effort should be spared to reduce present railway costs and, especially, labor costs. Present high labor costs are not due alone to present high wage scales, but are largely due to expensive working rules and to even more expensive interpretations and applications of them by certain bodies created by law. Third, we should spare no effort to get changes in present transportation policies of the federal and state governments which, contrary to the public interest, discriminate against the railways in favor of all other commercial carriers. Fourth, we have a broad duty as citizens; that is, to combat all the policies of government, business and labor by which we are trying to defy and override economic laws, the operation of which is essential to efficient functioning and preservation of a system of private enterprise.

Government, business, and labor, whether they know it or not or like it or not, must choose between free pri-

vate enterprise and state socialism. The longer they continue to socialize private enterprise, the more certainly they will cause state socialism.

Where do we go from here? That will depend upon whether we have enough men of intelligence, courage and patriotism to make enough efforts to get the American people to cause another economic revolution which will revive the great increases of production and commerce, and of railway traffic, earnings, and improvements that occurred before the war. It can be done. I believe it will be done, because I believe we have enough men of intelligence, courage, and patriotism to give the necessary leadership in the nation and in every state and community, and because I am sure the people are growing extremely tired of wallowing in the depths of this depression and will respond to the needed new leadership if it is offered them.

Report of Committee on Wheels

The committee, in its last report, commented upon the practice followed by some users of cast-iron wheels in connection with grinding the treads of the wheels either before or after mounting. In response to a questionnaire sent out by the secretary, soliciting information, replies were received from 27 railroads and private car lines, but in no instance was any definite information available. All replying to the inquiry seemed satisfied the grinding of the treads was a desirable practice, but as to the effect of such grinding, no definite information was available. The situation with respect to the value of ground wheels from the standpoint of reducing damage to lading was complicated where some information might have been available because snubbing devices have been applied to the trucks.

It is the opinion of your committee that the value of the use of truly round wheels will be reflected more in the reduction in truck maintenance than in a reduction in damage to lading.

Your committee is continuing its study of this subject and again solicits the roads following the practice of using ground wheels for any concrete information they may be able to develop with respect to the advantages obtained by this practice.

Single-Plate Bracketed Solid Hub Design Cast-Iron Wheel

The 1938 wheel committee report contained an account of authorization granted for certain types of experimental cast-iron wheels which included wheels with bracketed type plates and cored hubs. In this same report the committee expressed itself as being reluctant to accept the cored hub design without more intimate knowledge as to what might develop as a result of the cored hub.

In the meantime the Association of Manufacturers of Chilled Car Wheels developed and produced a bracketed single-plate wheel with a solid hub for 40,- 50- and 70-ton cars and requested authority to manufacture and place in service 100,000 wheels of each capacity, making a total of 300,000 wheels of this particular design. This request was approved by the General and Wheel Committees.

It is the opinion of your committee that the single-plate solid-hub, bracketed type wheel is a better design than the present standard single-plate wheel. This design has an advantage in that the plate is moved outward and thus better supports the outer portion of the rim and in this respect should be better protection against broken rims. Further, the bracketed feature on the back of the plate affords better support to the flange section and is claimed by the manufacturers to influence a more uniform chill.

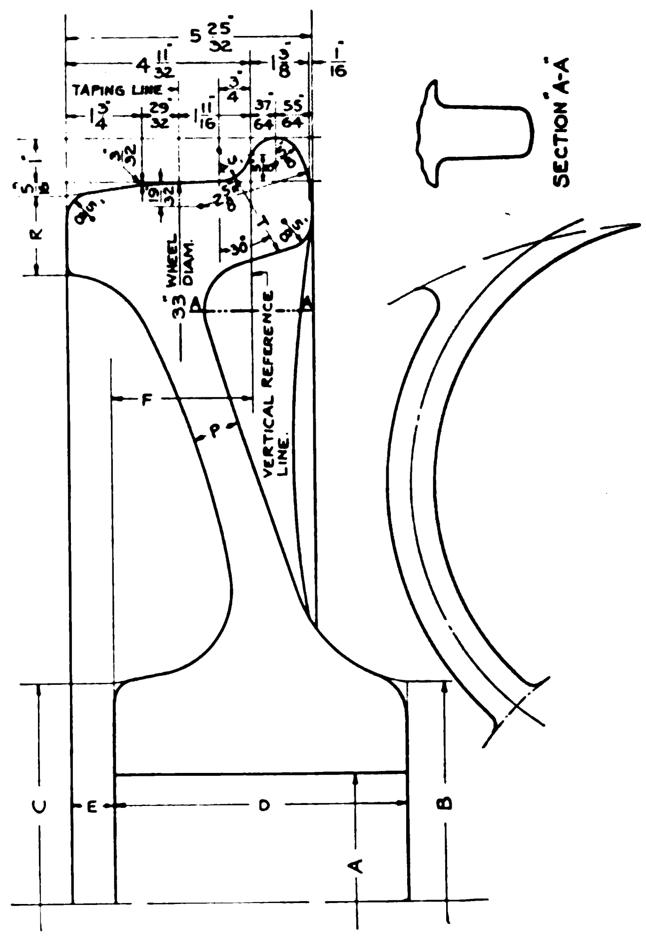
Your committee considers that the single-plate bracketed solid-hub type of wheel has sufficient advantages to warrant recognition over the present standard single-plate design and therefore recommends that the question of adopting this improved design of wheel to replace the present design of single-plate wheel be submitted to letter ballot of the members. This design of wheel is illustrated in Fig. 1.

The cast-iron wheel specifications have been tentatively revised, as shown in Appendix A, for study and consideration of the members during the coming year. (Appendix A is not shown in this abstract.)

Hub Clearance on Cast-Iron Wheels

A member road has reported that journal boxes, especially those on integral side frames, are contacting and being worn by the hub face of cast-iron wheels. This road requested that revision be made in the cast-iron wheel design to afford more clearance between the hub and journal box when journals, journal bearings, boxes, wedges, etc. are approaching the extreme limits of wear.

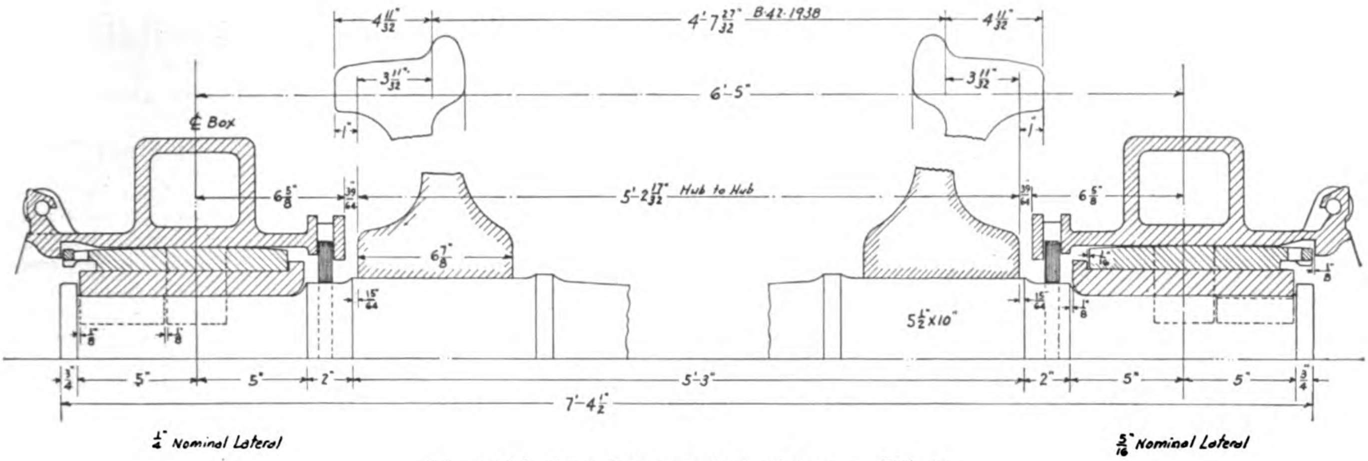
In a comparison of hub clearance as between the cast-iron wheel and wrought-steel wheel it will be noticed the cast-iron



Car Capacity	40-Ton	50-Ton	70-Ton
Nominal weight	700 lb.	750 lb.	825 lb.
Core size A	6 in.	6½ in.	7⅛ in.
Hub diameter, back B	10¼ in.	10¾ in.	11½ in.
Hub diameter, front, C	10¼ in.	10¾ in.	11½ in.
Length of hub, D	6⅞ in.	6⅞ in.	7⅝ in.
Front hub recess, E	1 in.	1 in.	1⅛ in.
Vert. ref. line to front hub, F	3 11/32 in.	3 11/32 in.	3 1/32 in.
Thickness of plate, P	1 in.	1 5/16 in.	1 11/32 in.
Thickness of rim, R	1⅞ in.	1⅞ in.	2 in.
Thickness thru throat, T	2 in.	2⅛ in.	2 5/16 in.
Number of curved brackets	12	13	14

Fig. 1—The single-plate bracketed chilled-iron wheel

wheel has 1/16 in. more clearance with respect to the vertical reference line than the wrought-steel wheel, but if cast-iron wheels are mounted to the extreme spacing limits provided by the mounting and check gage with the gage contacting the wearing face of both flanges, this apparent additional hub clearance would be taken up in the mounting process. If, however, the wheels are mounted centrally on the axle and according to the recommended practice, with the mounting and check gage contacting the back of one flange and the wearing face of the opposite flange, the cast-iron wheel would have an advantage of 1/16 in. with respect to hub clearance.



6 in. x 11 in. journals back to back of boxes = 63¾ in.
6 in. x 11 in. journals hub to hub = 62 9/32 in.

Total hub clearance 1 15/32 in. or 47/64 in. at each wheel

Fig. 2—This shows the relative location of the several parts with nominal lateral. The wheels and journal boxes are centrally located

It is recognized that under certain conditions the journal box will contact the hub of the wheel, but there are so many contributing causes to this condition such as wheels not being mounted centrally on the axle, wheels mounted to the extreme spacing limits and general condition of the truck structure so that journal-bearing and box wear on one side are not supported by contact between the journal bearing and the axle collar on the opposite side, that revision of the wheel design does not seem the proper point of attack.

The present wheel design with offset arrangement of the hub and the rim which is accepted because of structural limitations does not represent a well balanced design and this condition should not be aggravated by any further increase in hub depression.

It is the opinion of the committee that if the conditions reported are existing to the extent that some definite corrective measures should be taken, a careful detailed study should be made of the truck structure, the spacing of wheels as to their effect upon the undesirable condition and then the subject referred to the Car Construction Committee if changes in design to correct the condition are deemed desirable.

Figs. 2 and 3 show the method followed by the Committee in making this study. These are presented as information and guidance to those who may, in the future, be making a further study from the standpoint of conditions other than wheel influence.

Removal of Cast-Iron Wheels for Worn Through Chill

Statements have been received from two individual car owners that they are having an unusual number of wheels removed from their cars on account of worn through chill and the thought has been advanced that this condition is due to placing the worn through chill defect back in the judgment class.

Your committee investigated 90 wheels removed from various cars for worn through chill condition, which wheels were inspected and subsequently broken to definitely develop the extent of the chill. Out of 31 wheels inspected at one point, 28 wheels were worn through chill, 13 of which did not take the out-of-round gage, 3 were not worn through chill and did not take the out-of-round gage, but did take the remount limit gage.

At the other point where 59 wheels were inspected and broken, 55 wheels in this group were actually worn through chill, but only 3 would have been condemned by the out-of-round gage. The 4 wheels not worn through chill each took the out-of-round gage and could have been condemned under Symbol 73-R.

Summarizing, of the 90 wheels removed for worn through chill, 83 were found in this condition which indicates the inspectors condemning these wheels were a little over 93 per cent correct in their judgment of worn through chill condition. This inspection also definitely established that the out-of-round gage could not be taken as a correct means of indicating the condition of worn through chill.

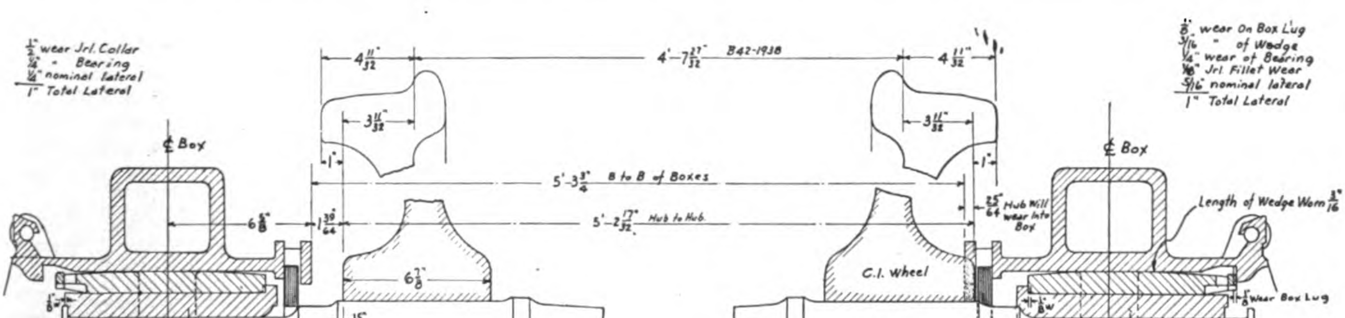


Fig. 3—Drawing showing wear of hub (cast iron wheel) into the journal box when the condemning limit of 3 3/16 in. between lug and end of bearing and ¼-in. journal collar is reached

Exhibit 1 of the 1937 report showed the roads reporting on the percentage of cast-iron wheels removed for different defects and that on Road *A* 19.47 per cent of the wheels were removed for worn through chill. Road *B* which is not a cast-iron wheel road showed only 3.72 per cent of the wheels removed for worn through chill, while Road *C* which is a cast-iron wheel road showed 27.08 per cent worn through chill. These figures were representative of conditions of wheels removed during the months of December, 1936, and January and February, 1937.

The committee is definitely of the opinion that the out-of-round gage is serving a good purpose from the standpoint of out-of-round condition but can not be recommended as a means of indicating worn through chill.

The committee has to date been unable to develop a definite gage for identifying the worn through chill defect and calls attention to the practice to be followed in identifying this defect shown in paragraph 102, page 117, of the Wheel and Axle Manual.

Measurement of Chill in Cast-Iron Wheels

The Association of Manufacturers of Chilled Car Wheels furnished information to the committee relative to its development of the new method of measuring chill in cast-iron wheels. Until recently this measurement was based on the judgment of the inspector from a visual examination of the fracture, which leads to wide variations in interpretation. The association set forth the steps leading up to the present method which is based on a definite relationship between the combined carbon and hardness as read either by Sceleroscope, Brinell, or Rockwell machines. Under the new method, wear requirements are satisfied with a hardness of 363 Brinell or 55 Sceleroscope taken 9/16 in. below the tread surface on the 3½-in. line. An upper limit is now being tentatively used which approximates the maximum passed under present methods of measurement in A. A. R. specifications. This calls for a Brinell hardness of 321 or a Sceleroscope hardness of 52 at a depth of ¾ in. below the tread surface. The association's statement concluded as follows:

"This method has gradually been introduced through our inspection department largely by careful education and detailed instructions on method of procedure and has now been effective for about twelve months, finally having been adopted by letter ballot of the members of the Association of Manufacturers of Chilled Car Wheels in connection with a general revision of specifications which are to be made effective June 1."

Multiple-Wear Wrought-Steel Wheels

Some service conditions to which wrought-carbon-steel wheels are subjected have developed within recent years which makes it necessary to give consideration to a heat-treated wheel in addition to those covered by A. A. R. Specification M-107. Service conditions have been imposing an increased burden upon wrought-steel wheels such as high wheel loads, high speed, braking requirements, as well as the design of the equipment and the condition of the track which it traverses.

Your committee has been collecting data relative to these special service requirements and the Technical Board of the Wrought Steel Wheel Industry has been diligently studying the problem and producing wheels of varying compositions and hardness characteristics that was felt were best adapted to the type of service to which they would be subjected. Sufficient data has been established to indicate that wheels representative of some type of heat treatment will be required to meet these various exacting service conditions and since there is no recognized practice prescribed for such wheels the committee, in conjunction with the Technical Board of the Wrought Steel Wheel Industry, are presenting for guidance a Tentative Specification for Heat-Treated Wrought-Carbon-Steel Wheels.

Of necessity this specification is of very general character and application, but it presents three different types of wheels classified as follows: Class A—High-speed service with severe braking conditions, but with moderate wheel loads; Class B—high-speed service with severe braking conditions and heavier wheel loads; Class C—service with high wheel loads and moderate braking conditions.

With this information available it will give the purchaser some basis upon which to make a selection. For instance, if trouble is being experienced with thermal cracking in high-speed service, and since thermal cracking is unquestionably connected with braking conditions, wheels according to Classes *A* or *B*, which have a comparatively low carbon content, would probably best meet this situation. Where trouble is being experienced on account of shelled treads which occurs frequently under locomotive tenders with heavy wheel loads, wheels corresponding to Grade *C*, which have a carbon range very similar to that of Specification M-107, but are heat treated to a minimum hardness of 321 Brinell will prove of value from the standpoint of resistance to shelled treads.

Suitable symbols stamped on the back face of the rim of each wheel identifies the class to which it belongs and provides against confusion in mating or identifying wheels for any particular service.

Removal of One-Wear Wrought-Steel Wheels for Built-Up Tread

It has been reported that owners of cars equipped with one-wear wrought steel wheels are suffering an unwarranted loss on account of wheels removed on foreign lines with built-up tread, the handling line contending that in accordance with Rule 98-(i), one-wear wrought steel wheels are not to be turned and consequently allowing the owning road only scrap credit for the removed wheel.

There is no reason why wheels removed for built-up tread should not be restored for further service by turning or grinding; grinding being preferable, as in the turning operation the cut would have to be taken below the work hardened surface of the tread at the expense of a greater loss of service metal. It is recommended that Rule 98, Par. (i), be modified as recommended below:

Proposed Form: Rule 98 (i)—The condemnable defects for wrought steel wheels in Rules 79 to 83 apply also to the one-wear wrought-steel wheel. Charges and credits shall not be on a service metal basis. Prices new, secondhand and scrap, as per Items 194-C and 194-D, Rule 101, shall be used.

Wheels removed account of having built-up metal on tread shall have this metal removed, preferably by grinding, or by turning where thickness of rim will permit. Note under Items 270, Rule 107, provides labor charge of 1.4 hours for grinding or turning.

The one-wear wrought steel wheel is identified by marking "1-W" on back of flange near wheel number or manufacturer's name.

Reason: To clarify the intent that one-wear wrought-steel wheels may be ground or turned to remove built-up metal on tread. See Par. 37 and Figs. 45 to 49, inclusive, in Wheel and Axle Manual.

Proposed Revision of Interchange Rule 69

In connection with the recommendations to adopt the single-plate, bracketed, solid hub wheel as recommended practice instead of the present single-plate wheel without brackets, some provision should be made for mounting on the same axles, wheels of the same nominal weight of the following designs: Experimental AARX single-plate wheel, present standard single-plate wheel, experimental AARX single-plate wheel with bracketed plate and solid hub, proposed recommended practice single-plate wheel with bracketed plate and solid hub.

In order to provide for such a procedure, suggestion is made that the fifth paragraph of Rule 69 be referred to the Arbitration Committee for revision substantially as follows:

Proposed Form: Cast-iron single-plate or single-plate bracketed solid-hub wheels varying in marked weight over 25 pounds must not be mounted on the same axle.

If the above change in Interchange Rule 69 is approved, the following revisions should be made in Interchange Rules 83 and 98:

Proposed Form—Rule 83 (1st par.): The application of double plate cast-iron wheels (regardless of date cast), of nominal weight less than 750 lb. to axles having journals 10 in. long or over, 700 lb. to axles having journals 9 in. long or over and 650 lb. to axles having journals 7 in. long or over; or cast-iron wheels without any weight cast thereon; or double plate cast-iron wheels cast prior to January 1, 1921; is prohibited.

Proposed Form—Rule 98, Sec. (c), Par. (5): Serviceable experimental cored hub wheels marked "A. A. R. X." when removed from service on account of defect in axle or mate wheel, shall be credited as scrap except when removed on account of Rule 32 condition in which event secondhand credit must be allowed for such undamaged wheel. Such wheels when subject to scrap credit shall be held and disposition requested from car owner. If car owner elects to have wheels returned, freight charges collect, shipping instructions must be furnished within thirty days from date of notification. No credit should be allowed for wheels so returned.

Interchange Rule 75

Considerable opposition has developed relative to interpretation given in last year's report regarding Rule 75. There was some contention that a change was made in Rule 75 without submitting the proposition to letter ballot. There were in fact no changes made in the rule. The Wheel Committee was asked for a definition as to what constituted a transverse crack extending into the throat of the flange. In an effort to define this reference more definitely, the committee suggested the interpretation note shown under Rule 75 and recommended a method of measurement.

It appears that some roads have used this interpretation to support the removing from service any wheels that show a slight checking in the throat of the flange and through this practice a hardship has been placed on roads whose wheels have been thus dealt with. To entirely remove the note without any further changes in Rule 75 leaves the reference to transverse cracks in the throat of the flange in the judgment defect class.

Cracks, regardless of their length, are considered as extending into the throat of the flange if they extend within ⅞ in. of the flange as measured with gage shown in Fig. 1, Interchange Rules, seems to be unduly restrictive. Under a strict interpretation of this rule, cast-iron wheels which show a fine checker network of thermal cracks in the tread would be condemned if this network comes within ⅞ in. of the flange. In this checker network, the cracks do not generally reach a length greater

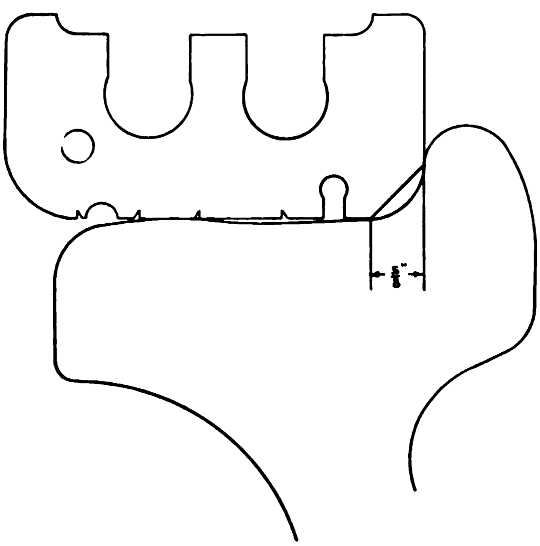


Fig. 1-A—Method of gaging brake burn transverse cracks extending into the throat of the flange of a cast iron wheel. See Rule 75

than ⅝ in., and inasmuch as they do not have any marked depth at this length, wheels with such cracks are safe to run.

The committee, therefore, recommends that the Arbitration Committee give consideration to revising the first paragraph of Rule 75 as suggested below and the note be eliminated.

Proposed Form: Brake burn, cracks: Cast-iron wheels with one or more transverse cracks in the flange or in the tread if over 2¾ in. in length, or if more than 1 in. in length and extending within ⅝ in. of flange as measured with gage shown in Fig. 1 and applied as shown in Fig. 1-A. See par. 107 and 108 and Figs. 83 and 85 in Wheel and Axle Manual.

If the foregoing recommendation is approved the third paragraph of Sec. (f)-3 of Passenger Car Rule 7 should be modified accordingly.

Proposed New Rule 75-A

Cast-iron wheels with a variety of tread defects, no one of which would condemn a wheel, are occasionally observed in service, the combination of defects being such that the wheel is not suitable for continued service.

Your committee has been requested to suggest a rule under which wheels unsuitable for service may be authoritatively removed because of such a combination of defects. In complying with this request it is recommended that the Arbitration Committee prepare a new Rule 75-A reading substantially as follows:

New Rule 75-A—Owner's Responsibility: Shelled out, flat spots, brake burn comby spots: Cast iron wheels having two or more defects not more than 3 in. apart and extending circumferentially on tread for a distance of 12 in. or more, as measured by the A. A. R. gage shown in Figure 76-A of the Wheel and Axle Manual, when such defects consist of any or all of the following: Shelled-out spots, one inch long or over but less than dimension shown in Rule 71; flat spots (except slid-flat spots), one in. long or over but less than dimension shown in Rule 71; brake burn comby spots, where metal has fallen out for a continuous circumferential length of ½ in. or over but less than dimension shown in Rule 75.

Removal of Wheels Loose on Axle

There has been brought to the attention of your committee a controversy developing between two roads, *A* and *B*, due to *A* removing from *B's* cars an unusual number of wheels account loose on axle. The position taken by *A* was there was indication these wheels were loose on account of oil seepage on the inside of the plate of the wheels.

No doubt every road at one time or other has been concerned about this proposition. In dismounting wheels showing oil seepage some will be found that are not loose on the axle, while the condition of other wheels fully justified their removal, and it is the opinion of the committee the roads can ill afford not to take every precaution against continuing in service wheels that may be loose on the axle even though an appreciably high percentage of wheels may prove secure when dismounted.

There is only one way to eliminate the removal of wheels on account of oil seepage and that is by better wheel-shop work through a higher degree of refinement in machining the axles, boring the wheels and in the fit tolerances observed. Improvement in these conditions, together with the use of the proper lubricant on the wheel and axle seats should insure wheel fits free from oil seepage.

Wheel-Shop Practices

The committee again wishes to emphasize the importance of wheel-shop work; that axles in their preparation have the wheel seat surface smooth machined and without taper, wheels be bored concentric with the tread and without taper and in the fitting of wheels and axles, the proper tolerances be observed to develop the desired mounting pressures when the A. A. R. recommended lubricant is used on the wheel seats.

In a recent investigation of wheel-shop practices covering inspection in 61 shops, only 44 per cent were rated as carrying on the work in conformity with standards prescribed in the Wheel and Axle Manual. The remaining 56 per cent were wholly or partially out of line with the practices recommended.

It is the opinion of your committee that if the Wheel and Axle Manual is put in the hands of all wheel-shop operators and sufficient support with regard to following the practices outlined is given by the higher mechanical officers, conditions such as observed in this inspection will be materially improved to the marked benefit of the operating road.

[The report included Appendix A giving tentative specifications for cast iron wheels and Appendix B for heat-treated multiple wear wrought carbon steel wheels. It also included the following notes on permissible wheel loads for wrought steel wheels, submitted by the Technical Board of the Wrought Steel Wheel Industries.—Editor]

Permissible Wheel Loads for Wrought Steel Wheels

The following notes are offered as a guide to the use of the various classes of wheels' covered by the tentative specifications for heat treated wrought steel wheels, and by the standard A. A. R. specifications M-107. A general summary is presented first, and this is followed by more detailed consideration of the main factors which affect wheel performance. Many of these factors cannot be covered by exact specifications, and it is therefore not possible to give hard and fast rules for the service to which the various classes of wheels should be assigned. It is hoped that the suggestions offered may be useful. As experience accumulates with the newer types of wheels, the situation can be clarified.

Until comparatively recent times standard operating conditions for which wheels to specifications M-107 were developed,

were represented approximately by maximum speeds of not over 70 m.p.h., and a service braking ratio of 90 per cent. Under such conditions satisfactory results can generally be obtained with untreated wheels to Specifications M-107, provided that the static wheel load does not exceed 600 to 650 lb. per in. of wheel diameter. Heavier wheel loads have been carried in tender service by heat-treated wheels with chemical composition in accordance with Specifications M-107. These are Class C wheels of the tentative specifications of October 6, 1938. Experience has shown that with these wheels difficulty may be expected with wheel loads in excess of 800 lb. per in. of wheel diameter with fully loaded tenders, and that loads of 850 lb. per in. or over represent wrong design.

In addition to the Class C heat-treated wheels of the composition covered by Specifications M-107, the tentative specifications offer two other classes, A and B, covering heat treated wheels with modified carbon content. These classes have been developed to minimize difficulties encountered in modern trains with high speeds and rapid deceleration. The large amount of heat generated on wheel treads by brake-shoe friction under high-speed conditions has caused undue thermal cracking. The modification of the carbon content has been made to provide greater resistance to thermal cracking of wheel treads.

It is not practicable to evaluate exactly the factors which determine the service for which these wheels are adapted. It is believed that Class A will have greater resistance to thermal cracking, but is intended for lower wheel loads. Class B is suggested for somewhat higher wheel loads with severe conditions of speed and deceleration.

It is to be understood that for both Class A and Class B wheels used with speeds much over 70 miles an hour, the wheel load per in. of diameter should be less than is allowed for wheels in moderate speed service and should be progressively reduced as the speed is increased. Exact relations between load and speed cannot be set up in the present state of knowledge. Further experience with wheels of these tentative compositions should clarify the situation.

Following this general summary of the uses of the wheels covered by the Tentative Specifications, the factors which affect wheel performance are considered in greater detail. Five important factors are: static wheel load, maximum train speed, braking requirements, conditions of track and design and condition of equipment.

Static Wheel Load

The static wheel load carried by the wheel in contact with the rail sets up compressive stresses in the tread of the wheel. Under normal conditions the area of contact between wheel and rail is small, and the compressive stress is high. The smaller the wheel diameter the smaller the area of contact for a given wheel load, and the greater the stress. Shelling is due to the break-down of the structure of the tread under repeated excessive compressive stresses.

Speed

Speed has a doubly injurious effect on wheel life.

(a) An increase in speed increases the impact force with which the wheel strikes rail ends, cross-overs, switches, and other irregularities in the rails. The impact forces add to the stresses due to static loading and increase the tendency to failure by shelling.

(b) An increase in speed increases the kinetic energy in the train. When brakes are applied this kinetic energy is transformed to heat by the friction of the brake shoe on the tread of the wheel. Overheating of the tread by braking from higher speed leads to the development of thermal cracks.

Braking

During braking, heat is generated by friction at the surface of the wheel tread in contact with the brake shoe. The rate at which this heat is developed is directly proportional to the wheel load, to the speed, and to the rate of deceleration. At high speeds even with normal deceleration the heat develops on the surface of the tread more rapidly than it can flow into the rim, and the tread metal rises to temperatures of 1,400 deg. F. and over. On emerging from beneath the brake shoe the tread metal is cooled rapidly by the flow of heat into the rim. This alternate rapid heating and cooling of the tread metal while the body of the rim remains at a moderate temperature, leads to the development of thermal cracks in the tread metal. It may also set up local stresses by producing quenched spots on the tread.

The rate at which heat is developed at the surface of contact between wheel tread and brake shoe is directly proportional to the speed, to the rate of deceleration, and to the load carried by the wheel. It, therefore, follows that if the rate of heat development is to be kept to a reasonable figure the wheel load must be kept down if speed and deceleration are to be increased.

It should be noted that as train speeds are increased it is natural to increase the rate of deceleration so as to avoid an undue increase in the distance required for stopping. Thus increase in train speeds frequently provides a double reason for using only moderate wheel loads. The rate of deceleration is directly proportional to the coefficient of friction between brake shoe and wheel and to the brake pressure ratio, which is the quotient obtained by dividing total brake shoe pressure on wheel by wheel load. As the coefficient of friction is beyond control an increase in rate of deceleration is obtained by increasing the brake pressure ratio. The increase in rate of deceleration thus produced increases, as has been seen, the rate at which heat is produced at the wheel tread.

Condition of Track

With track in poor condition the impact of wheels against irregularities in the rail may be greater than impacts at the same speed on better track. No exact valuation can be placed on this condition, but it may be one of the reasons why wheel damage is greater on one division than another. Curves also affect the service obtainable from wheels.

Design and Condition of Equipment

This is another factor which has a definite effect on wheel life, but which cannot be evaluated exactly.

It is known that in severe tender service the wheels on the front axle of the front truck develop more than their proportionate share of shelling, and in general the wheels in the front truck suffer more than the wheels in the rear truck. Similarly, wheels in some locomotive trailer trucks suffer an undue amount of damage under wheel loads which are not excessive for wheels in other positions.

The design and condition of the springs will affect the increase in load produced by impact. This effect will also be increased by any increase in the amount of unsprung weight carried by the wheels.

In conclusion, it is pointed out that intermediate factors, some of which have been noted, make it impossible to specify definite wheel loads which will be universally satisfactory. Loads low enough to avoid trouble under all conditions would be uneconomically low for many conditions. It is hoped that the railroads will study the results obtained in service by wheels to the Tentative Specifications and that with this experience they may be able to develop limiting wheel loads appropriate to their individual conditions.

The report was signed by H. W. Coddington (chairman), chief chemical and test engineer, Norfolk & Western; D. Wood (vice-chairman), engineer tests, Southern Pacific; E. E. Chapman, mechanical assistant, Atchison, Topeka & Santa Fe; W. R. Hedeman, engineer of tests, Baltimore & Ohio; J. Matthes, chief car inspector, Wabash; A. M. Johnsen, engineer tests, Pullman Company; E. C. Hardy, assistant engineer, New York Central; A. G. Hoppe, assistant mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific; and H. H. Haupt, general superintendent motive power, Central region, Pennsylvania.

Discussion

A member from a southern road directed attention to paragraph (3b) of the tentative specifications M-403-39, in which the specification says: "Drawn hubs will be accepted in a reasonable percentage of the total wheels presented for inspection . . ." The speaker suggested the deletion of the words "reasonable percentage" on the ground that it was not specific and that if any wheel involving such a condition were acceptable, why should not all wheels be acceptable. He suggested a more specific basis of rejection. At the close of the discussion the committee chairman explained that the reason for including this phrase in the report was to provide a rejection basis when

individual conditions seemed to warrant such action. The first speaker referred to also raised some question as to the sulphur content of wheel iron, making the comment that if a maximum of 16 points of sulphur were acceptable in some instances, whereas the specifications call for 14 points, why should not the 16-point maximum be acceptable in all cases.

(*The report was referred to letter ballot.*)

Report on Brakes and Brake Equipment

During the past year your committee has been actively engaged in a number of very complex and much involved subjects, some of which will require considerable further study before satisfactory conclusions and recommendations can be determined. However, we submit the following report for your consideration.

Cleaning and Testing Type-AB Brakes

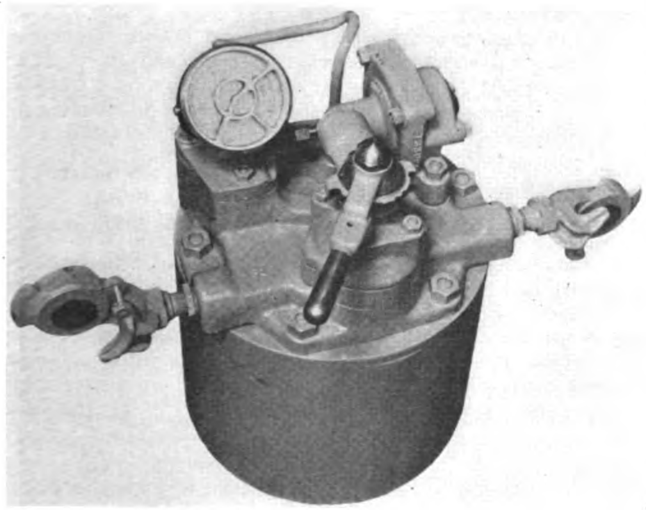
With the approval of the General Committee a short time ago, Sec. E of the Manual was revised, at which time substantial matter with reference to codes of tests and other items that are more or less subject to revision from time to time were deleted, inasmuch as they were a duplication of information contained in the respective air-brake manufacturers' pamphlets.

In this connection, the instructions covering the proper procedure to follow when cleaning and testing Type-AB brakes have been revised and were approved by the brake committee at its last meeting. These will appear in pamphlet form as published by the brake manufacturers and will be available for all those engaged in this work.

Although these instructions will appear under the sponsorship of the air-brake companies, they are issued with the committee's approval and will not be changed, modified, nor revised in any way without formal approval of the association.

Single-Car Test Devices and Test Codes

A few years ago some member roads complained that the present single-car test device with its code of tests would, under certain conditions, reject a Type-K triple valve that had successfully passed the 3-T triple-valve test-rack code of tests. A subcommittee confirmed these complaints and then considered



New single-car testing device

revisions to the code of tests, also the test device. With the assistance of the brake companies, a revised code of tests was prepared which, in practice, proved more or less inconvenient and difficult to carry out.

Inasmuch as the existing single-car test device could not be modified to remedy the conditions complained of, a further study revealed that a new design could be built that would be suitable for testing the brakes on any freight car of existing length and brake-pipe volume, as well as present passenger-car equipments.

The new design has been built and appropriate codes of tests prepared. It is our recommendation that this new design of single-car test device with its respective codes of tests be adopted as an Alternate to the present recommended practice device in order to obtain a wider experience with the new features it contains before offering such a device as a standard.

Modification of Freight Retaining Valve

In the committee's report last year reference was made to the present type of wasp excluder, also redesigning of the retaining valve to provide for larger passageways and additional protection.

The air-brake companies have submitted a further improved design of wasp excluder for application to existing retaining valves. Also a new design of retaining valve in which complete protection is provided against mud-wasps, together with complete protection against ice, sleet or other elements. However, some further consideration is necessary in connection with this new design and our recommendations with respect to it will be submitted in due course.

Since the last annual meeting complaints have been received of wheel troubles due to moisture entering the retaining valve, causing corrosion and stopping up the small relief port in the low-pressure cap. To remedy this, a molded rubber sleeve has been devised to fit over the low-pressure cap to protect the relief port.

The brake companies are now prepared to supply the latest design of wasp excluder and we recommend that it be accepted as an alternate to the one now generally used in order that a sufficiently wide application can be had definitely to determine its effectiveness in service.

We further recommend this design of molded rubber sleeve as a protection for the relief port so that a sufficient quantity may be applied to determine its effectiveness in service.

Standard and Lightweight Brake Beams

Since the No. 15 brake beam was adopted as standard, we have received several requests, principally from manufacturers, for approval of especially designed so-called lightweight beams for application to lightweight cars. These lightweight beams differ from the standard to the extent that most, if not all, their component parts are not interchangeable with it. In addition, they employ alloy materials.

The adoption of such a lightweight beam would involve a separate brake-beam specification and extensive revisions to the rules of interchange. In view of the fact that the only attractive feature in such a beam, and a very minor one, is a reduction in weight amounting to about 80 pounds per car set, any benefit in this direction would be more than offset by the inconvenience in effecting repairs in interchange and we are opposed to the introduction of any type of special design of lightweight beam unless all its component parts will interchange with the present standard.

The preparation of a standard No. 3 or No. 18 brake beam is well under way and our recommendations will be forthcoming in the very near future.

Brake-Head and Shoe Gages

In 1934, a price was established in the interchange rules covering the application of the standard A. A. R. brake-shoe key in repairs which was modified in 1935, resulting in a more general application of a properly dimensioned key. This has brought to light the fact that, when this standard key is driven down, it frequently damages the lug or loop of the brake shoe. To relieve this condition, we recommend two minor changes to the GO and NO-GO gage for the brake head shown as Fig. 3, page B-10-1936 of the Manual changing dimension *D* from ½ in. to 29/64 in. and dimension *E* from 13/32 in. to 25/64 in., respectively.

Power Brakes for High Speed Passenger Trains

The development and introduction of various designs of streamlined light-weight trains employing different types of brake equipments seemed to warrant deferring committee action pending the results obtained in service with them. In addition, and more recently, considerable activity appears in the development

of new and somewhat radical designs of brake arrangements of the disc, rotor and drum types, together with further improvements in valvular mechanisms.

From what we know, such new streamlined trains that are fitted with electro-pneumatic brakes, foundation brake gear of latest design, anti-wheel-sliding devices and effective means of sanding properly all wheels in the train simultaneously with the brake application, may be brought to a stop from a speed of 100 m.p.h. within the distance requested by the Bureau of Safety. As we understand it there are but few such trains in service; therefore, the problem pertains primarily to trains consisting wholly, or in part, of conventional units in high-speed train service.

Our committee is convinced that present conventional passenger trains cannot be brought to a stop in 1,200 ft. from 60 m.p.h. with the distance increasing at higher speeds in proportion to the square of the speed, or even within 3,600 ft. from a speed of 100 m.p.h.

Obviously, there are two basic problems involved—first, how can the necessary rate of retardation be obtained and, second, if and when it is obtained, will the rail-wheel adhesion be so encroached upon as to cause intolerable wheel sliding? If so, how can the latter be avoided without sacrificing the former? The answers to these basic problems are not so easily found as may at first appear. Physical limitations are very definitely before us in certain phases of this study; in others, only partial and minor assistance seems possible. We are, however, investigating every feature involved, including the mass of data compiled from the various and numerous high-speed train brake tests made from 1913 to date in the hope of realizing the objective set for us with the least possible disturbance and revision to existing fundamental brake schedules and arrangements. Whether this is practicable we cannot at this time say.

We expect to be in a position to report more definite progress in the near future. In the meantime, the foregoing is submitted for your information.

Manual Duplex Release Valve

It appears there are two features in the Type-AB release-valve stem about which complaints have been received. One is that the release-valve stem is too slender in design to withstand the conditions imposed upon it. The other is that when the release valve is pulled wide open from the short release rod and near the valve to bleed both the auxiliary and emergency reservoirs, dust, gravel, cinders, etc., are blown into the operator's face and eyes.

The air brake manufacturers have redesigned the stem, strengthening it very materially and at the same time have provided a deflector plate just below the release-valve opening which deflects the blast of air away from the operator immediately the air is released.

We are satisfied both these improvements are desirable, and it is our recommendation that this latest design be supplied on all new Type-AB valves as soon as the brake manufacturers can provide it and that it also be applied to existing Type-AB valves when release-valve stem renewals are made.

The question of permission to renew detail parts or portions of Type-AB equipment when the stenciling is in date and the brake operative was referred to our committee for advice. It is our unanimous opinion that, where it is necessary to give any attention to either portion of the Type-AB valve or the brake cylinder, the entire brake should be given attention in accordance with Interchange Rule 60.

Location of Angle Cocks on Long Freight Cars

It was brought to our attention that the present standard dimensions covering the location of angle cocks as shown on page 31—1928, Section E of the Manual was not satisfactory for long freight cars and that when located to these dimensions much trouble and inconvenience is occasioned around industrial and mill tracks. After investigating the matter we agree they are not satisfactory for such operating conditions and should be revised.

(The committee recommended changes in Fig. 1 on page 31 of Section E of the Manual, the principal revision lowering the angle cock 1½ in. Otherwise the dimensions as now generally followed remain the same with maximum and minimum limits. —Editor.)

Where the angle cock is located at or near the horizontal minimum, interference may be experienced with the horizontal draft key, and this matter will be taken up with the Committee on Car Construction to see what can be done to avoid the necessity of relocating the brake pipe immediately back of the angle cock.

Lubrication of Air Brakes

During the past year serious consideration has been given to the question of satisfactory lubrication of car air-brake equipment, which includes lubricating oil for valve pistons, bushings, rings, etc., dry graphite for slide valves and seats, and grease for the brake cylinders.

The present standard rules of maintenance specify that the Type-AB valve pistons, rings, bushings, etc., must be lubricated with an approved kind of oil that the brake cylinder must be lubricated with a suitable brake-cylinder lubricant, but we have not yet specified what an approved oil or suitable brake-cylinder lubricant must be. The result is that many railroads are using various grades of oil and grease which are entirely unsatisfactory.

The number of Type-AB valves that are given attention as per Interchange Rule 60 before they have seen even two years' service provides ample evidence that the inferior kinds of lubricants used are primarily responsible. There is no doubt in our minds that, where satisfactory lubrication is practiced, the Type-AB brakes will give satisfactory service for at least three years but, unless approved lubricants are used, they cannot run their present allotted time.

The duration of service expected from these brakes demands special consideration in this respect and, when our recommendations are submitted, we shall, in all probability, ask for the adoption of strict regulations to ensure the economy anticipated by the adoption of these brakes as Standard.

Periodical Attention to Hand Brakes

It has been suggested by a member road that attention to geared hand brakes should be more definitely provided for in the Interchange Rules in order that they be attended to along with some other item given periodical attention.

The present rules for Maintenance of Brake and Train Air Signal Equipment, item 103, provides for the necessary attention to hand brakes on cars on shop or repair tracks with stencils "in date," but there is no regulation covering the same when cars are on shop or repair tracks for periodical attention to air brakes.

The joint subcommittee on geared hand brakes recommends the following paragraph be inserted as a new Sec. (n) to Interchange Rule 60: "(n) When car is on shop or repair track for air-brake cleaning and testing, the hand-brake mechanism and connections must be inspected, repaired and lubricated if necessary and tested to insure it is in suitable condition for safe and effective operation."

Maintenance of Train Air-Signal Equipment

The Bureau of Safety, Interstate Commerce Commission, has requested that steps be taken to incorporate in the rules for "Maintenance of Brake and Train Air Signal Equipment" definite requirement regarding the train air-signal equipment and that necessary improvements be made in the train air-signal equipment to insure its proper functioning. A subcommittee now has the matter under consideration.

Hose Clamp Bolts

Attention has been drawn to the practice of some roads when mounting hose square nuts are being used instead of hex nuts as shown for the air hose on page 16, Sec. E of the Manual. This is intended to show only the location of the hose label and the correct mounting position of the bolting lugs or clamps. It is immaterial whether square or hex nuts are used.

In addition to the foregoing, the following items are among those under active consideration by our committee: Air-hose couplings and gages for air-hose couplings; maintenance of brake beams and their attachments; charging time limit for AB valves on repair tracks; corrosion of air-brake equipment; maintenance of passenger-car metallic connections and gaskets; reclamation

of brake levers and inspection and tests of D-22 control valves.

We also wish to record our appreciation of the valued assistance given by the air brake companies on subjects jointly discussed with them; also, for their laboratory facilities in which considerable study was made.

The report was signed by W. H. Clegg (chairman), chief inspector air brakes and car heating equipment, Canadian National; T. L. Burton, air-brake engineer, New York Central; C. H. Rawlings, general air-brake instructor, Denver & Rio Grande Western; R. C. Burns, general foreman, Pennsylvania; L. S. Ayer, general air-brake inspector, Southern Pacific; J. P. Stewart, general supervisor air brakes, Missouri Pacific; R. E. Baker, general air-brake inspector, Boston & Maine; R. J. Watters, general air-brake inspector, Northern Pacific; J. A. Burke, supervisor air brakes, Atchison, Topeka & Santa Fe, and Otto Swan, air-brake inspector, Union Pacific.

Discussion

The committee chairman, after his presentation of the report, read a supplement to the 1939 report which was added with the idea of minimizing the damage to air-brake hose as a result of couplings pulling apart. This supplement read, in part, as follows: "In an effort to minimize this [damage] a minor change to the hose coupling and nipple has been suggested by the brake companies which the brake committee has approved. This change provides for distributing the stress in the air-hose fabric over an increased number of cords by increasing the radius of bearing for the inner surface of the hose when the air-hose couplings are pulled apart." This change in the dimensions of fittings affects only new fittings purchased and does not affect the status of existing fittings.

(The report was accepted and the recommendations referred to letter ballot.)

Report on Labor and Material Prices

In order that the rules may currently provide an equitable basis for inter-road billing, the committee has continued the work of analyzing material, labor and new equipment costs in A. A. R. Interchange Rules 101, 107, 111 and 112 of the Freight Car Code, and Rules 21 and 22 of the Passenger Car Code, with a view of determining and recommending necessary changes to be made in the next supplement to the current code.

Freight Car Rule 101

All miscellaneous material prices in Rule 101 were rechecked as of March 1, 1939, quotations submitted by the purchasing agents of the ten selected railroads, representing 39 per cent of total freight-car ownership in the United States and Canada, indicating a rather mixed trend in material markets as indicated by detail recommendations for revisions shown under this rule.

New Item 114-A is added to provide charge for high-tensile steel castings when standard to car. Item 188-D modified to make clear that charge for high-tensile steel is permissible only providing such material is standard to car.

Item 121 modified to clarify the intent.

A new second note is added to Item 155-A, to indicate the intent that the additional charge for removal and replacement of monogram plates, sign plates or placard holders secured to doors, is proper in connection with door renewals.

Item 160 is modified to clarify the intent that allowance specified for hatch plug for refrigerator car does not include chain and chain bolt.

Item 182 is modified to provide a charge for ratchet wheel shims applied in order to correct loose or worn condition between ratchet wheels and square fit brake shafts, and thus avoid the additional expense that would be incurred if brake shaft was removed, repaired and replaced or renewed, as recommended by the Arbitration Committee and the Committee on Brakes and Brake Equipment.

A new second note is added to Item 194-A to definitely indicate the intent with respect to charges and credits for multiple-wear wrought-steel wheels originally over 33 in. in diameter, which have reached condemning limit for passenger service and been assigned to freight service.

The second sentence of the first note under the heading "Friction Draft Gears" is modified to clarify. One new conditionally approved type of draft gear, Waugh-Gould 410, has been added to Section I of the draft gear table, together with a note explaining just what "conditionally approved" signifies and that such gears are to have the same status as approved types insofar as substitutions, charges, credits and other provisions of the Rules are concerned. Two new types of Peerless gears have been added to the non-approved section of the table and a clause inserted to indicate that prices listed for all four Peerless non-approved types of gears are exclusive of springs, spring rods, spring caps and cotters; the note following Item 277 being modified to harmonize.

Weights of brake hangers, brake levers and brake connection rods other than bottom rods, appearing in table of weights of miscellaneous items, have been increased 2 lb. each.

Interpretations Nos. 4 and 7 have been modified to clarify.

Rule 107

New Item 102-A added, to provide equitable allowance for renewal of journal box rivets in cases where side frames with Vulcan journal boxes are secured with rivets instead of bolts, in connection with removal, repair and replacement of journal box, truck side or wheels.

The second note following Item 48 modified, new third note added to Item 126 and a new note added to Item 296, to clarify the intent.

Rule 111

No modifications are recommended in this rule.

Rule 112

Recommendations are made in this rule respecting reproduction pound prices of new freight cars of all classes, in order that the supplement of August 1, 1939, may reflect 1938 costs in lieu of figures shown in the present code. New prices recommended are based on costs of 8,847 freight cars constructed during the year 1938.

Passenger Car Rule 21

In order to eliminate controversy and correspondence, a new note is added to Item 7 of this rule to indicate definitely where allowances for removal and replacement or renewal of bolts are applicable.

Items 20-B and 20-C are modified to clarify the intent that allowances specified for cleaning, oiling, testing and stenciling P. C. and U. C. control valves, include labor of making necessary repairs.

Item 20-K was modified to clarify the intent that this item does not apply to manually-operated slack adjusters.

Passenger Car Rule 22

Item 21 was modified to clarify the intent that same applies only to journal box lubrication and does not contemplate lubricating of pedestal, center plate and buffer stem oil cups, etc.

The notes following Item 41 have been numbered as Notes 1 and 2 and wording of Note 2 modified to clarify.

New Item 44 added to provide net charge for vestibule curtains applied complete.

As a result of questions raised in connection with present labor allowances for various rivet and jacking operations, the committee has arranged to conduct time studies on representative railroads in various sections of the country. If modifications are found necessary, revision will be made in the 1940 code.

It is the intent of the committee to investigate labor and material costs again in October and if sufficient change develops, necessary revision will be made and inserted in the rules effective January 1, 1940.

[The changes recommended in the existing rules are shown in detail in the report.—Editor.]

The report was signed by A. E. Calkins (chairman), superintendent of equipment, New York Central; A. E. Smith (vice-

chairman), vice-president, Union Tank Car Company; J. D. Rezner, general car foreman, Chicago, Burlington & Quincy; P. Kass, superintendent car department, Chicago, Rock Island & Pacific; T. J. Boring, general foreman, M. C. B. clearing house, Pennsylvania; H. H. Boyd, assistant chief motive power and rolling stock, Canadian Pacific and A. H. Gaebler, superintendent car department, General American Transportation Corporation.

(*The report was adopted.*)

Report on Tank Cars

During the past year the committee considered a total of 315 dockets and applications for approval of designs as follows: 157 covered designs, materials and construction of 2,176 new shipping containers for application to new cars or for replacement on existing cars of 17 classes. The five classes with the largest number of tanks were I. C. C.-106-A-500, 1202 tanks; I. C. C.-103, 324 tanks; I. C. C.-103-W (fusion-welded seams), 170 tanks; I. C. C.-105-A-300-W (fusion-welded seams), 100 tanks, and I. C. C.-105-A-300, 95 tanks.

Two applications covered five multiunit cars to be used for the transportation of 15 Class I. C. C.-106-A-500 one-ton containers each. Six applications covered 20 new underframes and trucks on which would be mounted existing tank-car tanks.

A total of 110 applications covered alterations in, additions to or conversions and reconditioning of 1,382 existing tank cars of 13 different classes.

Thirty-five applications requested approval of tank-car appurtenance designs, without reference to specific cars.

Specifications for Tank Cars

The committee has completed a proposed general revision of the Interstate Commerce Commission specifications for tanks to be mounted on or to form part of a car, referred to in our last report. This proposed general revision has been submitted to the commission for the necessary further handling.

Specifications for Fusion Welded Tank Car Tanks

The committee is at present engaged in a general revision of the specifications for fusion-welded tank car tanks, as submitted to the I. C. C. in 1934. When completed these revised proposed specifications will be submitted to the commission, along with reports covering service performed by existing fusion welded tanks in dangerous commodity service. The committee will, at the same time, in view of the satisfactory service performance of the tanks so fabricated, recommended the adoption by the commission of these proposed revised specifications.

Fusion-Welded Tank Car Tanks

Since the public hearings before the I. C. C., at Washington, D. C., on September 5, 6 and 7, 1934, on the matter of fusion-welded tank-car tanks the commission has authorized the construction of a total of 708 tank-car tanks, fabricated to conform to the proposed specifications then submitted, and their use in experimental service trials in transporting dangerous commodities.

To date 233 of these fusion-welded tanks have been constructed and placed in experimental service trials.

Two of the cars on which these tanks were mounted have been involved in wrecks resulting in considerable damage to the car structure, tank insulation and jacket. The fusion-welded tanks however suffered no apparent injury and after being subjected to hydrostatic tests and a thorough examination were returned to the service authorized by the commission's orders.

One fusion-welded tank failed as the result of a progressive fracture in the bottom sheet due to an internal defect impossible of detection by any ordinary method of inspection. This fracture, 3 in. long, including the initial internal defect in the sheet, was located on the transverse center line and extended circumferentially in the tank sheet, from the junction of the anchor-rivet-cover side wall with the tank shell, toward the sump. It was approximately 6 ft. from the single horizontal and a similar distance from the two circumferential fusion-welded seams of the middle course. The subcommittee appointed to investigate the failure of this tank were of the unanimous opinion it was not due to the use of fusion welding in the fabrication of the tank.

Service reports are regularly received covering all fusion-welded tank-car tanks authorized for experimental trials. These indicate a satisfactory performance for the fusion-welded tanks now in service.

One riveted aluminum tank has been constructed and placed in experimental service trials transporting dangerous commodities on authority of the I. C. C.

The report was signed by G. S. Goodwin (chairman), mechanical engineer, Chicago, Rock Island & Pacific; F. A. Isaacson (vice-chairman), engineer car construction, Atchison, Topeka & Santa Fe; A. G. Trumbull, chief mechanical engineer, Chesapeake & Ohio; G. McCormick, general superintendent motive power, Southern Pacific; W. C. Lindner, chief car inspector, Pennsylvania; A. E. Smith, vice-president, Union Tank Car Company; G. A. Young, head, School of Mechanical Engineering, Purdue University; F. Zeleny, engineer of tests, Chicago, Burlington & Quincy; W. C. Steffa, transportation manager, Sinclair Refining Company; R. T. Baldwin, secretary, The Chlorine Institute, Inc.; H. J. Gronemeyer, supervisor car equipment, E. I. DuPont deNemours & Co., Inc.; and R. W. Thomas, manager, Philgas department, Phillips Petroleum Company.

(*The report was accepted.*)

Report of Committee on Loading Rules

Since the last convention held at Atlantic City in 1937, your committee has held several meetings with the shippers, at which time recommendations for changes and additions to the loading rules were considered. In addition to this, several meetings were held by the committee as a whole, as well as the sub-committees, to consider and formulate rules based on recommendations submitted by the shippers and member carriers.

Considerable experimentation of trial loads embodying new forms of loading have been tried out, notable of which involved the steel and lumber industries. These loads have been followed to destination so as to determine their feasibility insofar as safety and practicability of such loadings, with very gratifying results.

The committee wishes to extend to the shippers and member carriers its sincere thanks for the splendid cooperation it has received in its work and is indebted to their representatives for their very able assistance.

As the result of these deliberations, your committee submits the following recommendations covering changes in the rules for your approval and submission to letter ballot for adoption by the Association.

General Rule 1

Change the next to the last sentence to read: "Shippers must confer with originating carriers regarding safe loading of material not covered in these rules, and exacting care must be exercised to see that the details specified in Rules 1 to 21, inclusive, are fully complied with."

Reason: To more clearly indicate what is desired.

General Rule 3

Change to read as follows: "Clearance—Side Bearing—Loaded Cars.—There must be sufficient clearance between side bearings to permit free curvature of trucks and the average clearance per side bearing should not exceed ¼ in."

Reason: To reduce shopping of loaded cars for side-bearing adjustments in transit.

General Rule 20

Change first sentence to read: "When loading material (metal or stone) which is short enough to drop through door openings in gondola cars, and which is not of such character as is in-

tended to be unloaded through the drop door openings (stone larger than ballast, fluxing, and small stone, or metal other than borings, turnings, loose tin and sheet steel cuttings not more than 1/8 in. thick), the door openings must be covered with boards not less than 2 in. thick, secured to prevent displacement."

Reason: To retain boards in original position.

Instructions—Experimental Loads

Insert new paragraph between paragraphs 3 and 4 to read as follows: "Shipper, after having received authority for experimental shipments, will be furnished stickers worded as outlined below. He will affix one to bill of lading and attach another to be affixed to waybill by agent. This to insure proper handling of experimental load cards."

Reason: To insure proper handling of experimental load cards.

Sticker for Bill of Lading and Waybill

The Association of American Railroads, through the Committee on Loading Rules, has authorized the application of experimental load cards to Car.................................
These cards must be removed at destination by Car Inspector or Agent who must answer the questions on one of the cards and send it to the Secretary, Mechanical Division, Association of American Railroads.

[The rest of this report was devoted to recommendations covering proposed changes in details of various types of loading as illustrated in Figs. 2 to 209-A of the loading rules. New minimum requirem?nts are given in detail for such commodities as plain steel plates, wire mesh or bar mats, rolled wire mesh, mounted car wheels and tractors with pneumatic tires.—Editor]

The report was signed by W. B. Moir (chairman), chief car inspector, Pennsylvania; C. J. Nelson (vice-chairman) superintendent interchange, Chicago Car Interchange Bureau; R. H. Dyer, general car inspector, Norfolk & Western; H. H. Golden, supervisor; A. R. A. Interchange and Accounting, Louisville & Nashville; H. S. Keppelman, superintendent car department, Reading; T. W. Carr, superintendent rolling stock, Pittsburgh & Lake Erie; and A. H. Keys, district master car builder, Baltimore & Ohio.

Discussion

In discussing this report C. J. Nelson, superintendent of interchange, Chicago Car Interchange Bureau, said that the drastic speeding up of freight trains has greatly increased the necessity of safe loading of commodities on open-top cars and that necessary rule revisions must be made from time to time to increase the safety of train operation. Formerly these revisions which increased the strength and, to some degree, the cost of loading were accepted freely by shippers, but, under present highly competitive conditions shippers will not agree to pay the increased cost unless they can be shown that it is absolutely necessary.

To illustrate this point, Mr. Nelson said that lumber loads present the greatest possibility for failure in transit and that the committee's recommendations for increased strength in loading methods could not be made to stand up with lumber shippers, because the committee lacked sufficient specific data to prove the urgency of the rule revisions. In an attempt to develop this factual information, the committee sent out questionnaires to 300 roads and received replies from only 72. Mr. Nelson said that unless better cooperation is secured from individual roads in providing this information, the work of the committee will be largely nullified.

Mr. Nelson also urged a closer adherence to the loading rules and a discontinuance of the practice now far too generally followed of accepting cars from shippers not loaded in accordance with the rules. In support of this statement Mr. Nelson cited the case of a large crane loaded on a flat car and secured in place with eight strands of 1/8-in. wire, instead of 1¼-in. to 1½-in. anchor rods as recommended. Many other instances of rule violations could be mentioned.

An appeal was also made for more cooperation in properly filling out and returning the experimental-load cards, only 10 per cent of which now get back to the committee and some of these convey only a small part of the information requested.

Mr. Nelson said that shippers generally are entirely agreeable to go along with somewhat increased loading costs in the interests of greater safety when they can be convinced of the real necessity for the increase. In closing his remarks, Mr. Nelson paid tribute to Secretary Hawthorne's invaluable help in maintaining favorable relations with shippers and convincing them that the committee is earnestly endeavoring to work in their interest, as well as that of the railroads, in promoting safe loading practices at minimum practicable expense.

(The report was accepted and referred to letter ballot.)

Report on Specifications For Materials

The committee during the past year has reviewed all of the material specifications and considered comments and criticisms submitted by the members and others. The following revisions are submitted for your consideration:

Specification M-101-37—Axles, Carbon Steel, for Cars and Locomotive Tenders.—The scope of this specification has been revised to include axles up to and including Class E instead of up to and including 6½ in. in nominal diameter at the center.

Specification M-108-37—Boiler Tubes, Lap Welded, Electric Resistance Welded, and Seamless Steel, and Lap-Welded Charcoal Iron.—This specification has been revised to include specific reference to electric resistance welded tubes and to include a thickness tolerance specification for tubes manufactured by this process.

Specification M-111-36—Pipe, Furnace-Welded, Electric Resistance Welded, and Seamless Steel.—A number of typographical revisions and changes in A. S. T. M. and A. S. A. references to agree with the latest revisions were recommended.

Specifications M-302-37, M-304-36, and 305-36.—The first of these specifications covers refined wrought-iron bars, in which a typographical correction is noted which has already been made in the Manual. The other two specifications cover hollow-rolled and solid staybolt iron, respectively. Reference to iron scrap has been removed from the definition section of these two specifications.

Specification M-402-34—Malleable Iron Castings.—The following sentence has been added to the process section of the specifications: "Castings shall be free from primary graphite."

Specification M-911-39—Brushes.—This is a new specification which has been written to cover brushes—bristle, hair, fibre, and wire. The specifications cover paint and varnish brushes for master painting and utility purposes in general railroad use, as well as roofing, scrub, wash, duster, and wire brushes which are in general use.

Specifications for Car Oil and Renovated Journal-Box Packing.—As a result of joint conferences of the Committee on Specifications for Materials and the Lubrication Committee, revisions and new specifications have been prepared covering reclaimed car oil, new car oil, and renovated journal-box packing. Specification M-904-39—Renovated Car Oil—has been completely rewritten to include detailed instructions on the procurement and handling of samples and methods of analysis. The properties of car oil, recovered from used journal-box packing after passing through the renovating process, which are acceptable under the specifications are shown in the table. Specification M-906-39—New Car Oil—has also been completely rewritten to include more details of methods for sampling and analysis. The prop-

Required Properties of Renovated Car Oil Recovered from Used Journal-Box Packing

Items	Requirements
(1) Flash (open cup)	Not less than 300 deg. F.
(2) Saybolt univ. viscosity at 210 deg. F.	Not under 45 sec.
(3) Saybolt univ. viscosity at 100 deg. F.	Not over 725 sec.
(4) Water	Not over 0.20 per cent
(5) Total impurities, including tarry matter	Not over 0.75 per cent *
(6) Qualitative test for mineral acidity	Zero
Qualitative tests for alkalinity	Traces

* Lead and lead compounds will not be considered as impurities. Total lead in impurities shall be calculated as lead oxide (PbO) and subtracted from total impurities.

erties specified, however, have not been changed except for the addition of the requirement that the oil must be neutral to methyl orange and phenolphthalein. New Specification M-910-39 covers renovated journal-box packing. This includes the general subject matter now covered in Rule 66 and in Methods of Analysis of Reclaimed Waste—Section L of the A. A. R. Manual, amplified as to details and methods of sampling and methods of analysis. The properties to which the renovated journal-box packing are required to conform are given in the table. Suitable revisions of Rule 66 and Section L of the Manual to conform with the new packing and revised oil specifications are also recommended.

Required Properties of Renovated Journal-Box Packing

Items	Packing
Clean dry waste	20 per cent min.
Total impurities (including tarry matter)	5 per cent max.
Water	2 per cent max.
Oil	Balance

NOTE:—Percentages, based on weight of original sample, as 100 per cent.

The report was signed by T. D. Sedwick (Chairman), engineer of tests, Chicago, Rock Island & Pacific; E. E. Chapman (Vice-chairman), mechanical assistant, Atchison, Topeka & Santa Fe; Frank Zeleny, engineer of tests, Chicago, Burlington & Quincy; H. G. Burnham, engineer of tests, Northern Pacific; H. P. Hass, engineer of tests, New York, New Haven & Hartford; J. R. Jackson, engineer of tests, Missouri Pacific; H. G. Miller, engineer of tests, Chicago, Milwaukee, St. Paul & Pacific; J. W. Hergenhan, assistant engineer, test department, New York Central; L. B. Jones, engineer of tests, Pennsylvania; C. R. Bryant, engineer of tests, Southern; and W. R. Hedeman, engineer of tests, Baltimore & Ohio.

(The report was accepted and the recommendations referred to letter ballot.)

Lubrication of Cars and Locomotives

Your committee has held one meeting during the past year at which time a joint conference was held with the Committee on Specifications for Materials to consider tentative specifications covering (1) renovated car oil and (2) renovated journal-box packing. These specifications were developed jointly by members from the two committees and the results are included in the report submitted by the Committee on Specifications for Materials.

The Committee on Lubrication joins the Committee on Specifications for Materials in recommending that Specifications M-904-39, Renovated Car Oil, and M-910-39, Renovated Journal-Box Packing, together with the proposed changes in Rule 66 of the 1939 Revised Code of Rules, and Page 35-B-1937, Section L, of the Manual be approved for submission to Letter Ballot.

A. A. R. Interchange Rule No. 66

It is appreciated that there has been some degree of improvement in the results obtained from better lubrication practices instituted with the adoption of A. A. R. Rule 66. Nevertheless, the anticipated benefits to be derived from the rule cannot be fully realized so long as cars are stencilled as being repacked without conforming to full requirements of the rule.

Despite the better performance record, there is great opportunity for further improvement when considering the effects and related costs resulting from burned-off journals, the cost of setting out a car enroute in a train, the complications from a traffic standpoint, and the cost of reconditioning damaged journals for continued service. Increased speeds to meet highway competition make the main objective one of uninterrupted train operation and to that end journal lubrication plays an important part.

To reflect some idea of the situation, the record for the year 1938 of one large eastern road shows 7,846 freight-car hot boxes with an average of 195,000 miles per hot-box failure. The total train detentions due to journal heatings amounted to approximately 2,800 hours. Of the total number of hot boxes, 47 per cent occurred on owned cars representing 74 per cent of the cars on line; 30 per cent on foreign railroad cars representing 17 per cent of the cars on line, and 23 per cent on private line cars, representing 9 per cent of cars on line.

It is the feeling of your committee that substantial improvements can be further realized if Rule 66, with modifications now being submitted for approval, and other related A. A. R. standards are adhered to. It should be noted that a new requirement is included in Rule 3 of the 1939 Code of Rules for the interchange of traffic to provide that, effective January 1, 1940, packing for journal boxes must be prepared and boxes repacked in accordance with A. A. R. standard practice, as defined in Rule 66, on all cars from owners. Furthermore, the necessity for strict compliance with the rule has been emphasized by letter of January 16, 1939, on behalf of the General Committee addressed to the members and car owners.

The time limit for periodic repacking of journal boxes is now fifteen months. The committee has been asked to consider a proposal to reduce that limit to twelve months, predicated on a study made by one member road of 1,783 hot boxes.

Using the data from this road to compare with a similar study made by a second member road to indicate in what elapsed time after the stencilled packing date heatings occurred, the following comparative statement is presented:

	Road A		Road B	
	No. of heatings	Per cent of total	No. of heatings	Per cent of total
Within 2 months	149	8.4	1,086	14.6
From 3 to 6 months, incl.	557	31.2	1,871	25.1
From 7 to 10 months, incl.	487	27.4	1,899	25.5
From 11 to 15 months, incl.	465	26.0	1,764	23.7
Over 15 months	125	7.0	830	11.1
Total	1,783	100.0	7,450	100.0

It should be noted that in the case of Road A 67 per cent of the total heatings occurred within ten months of the stencilled packing date and for Road B 65.2 per cent occurred within the same elapsed time.

It is generally recognized that journal-box packing of inadequate quality is a contributing cause of journal heatings. Stencilling of cars but failing to perform all the work as required by Rule 66; using improperly prepared packing or improperly applying good packing does not help to produce satisfactory lubrication performance.

Change of packing in the spring and again in the fall has been advocated but as this procedure would seem to be impracticable as well as costly, it is the opinion of the committee that before shortening the repacking period it would be advisable to comply with the accepted and recommended measures for protecting journal lubrication after which further data could be developed.

Method of Packing

In the method of packing boxes, some roads deviate somewhat from details outlined as standard practice in Rule 66, particularly for passenger service. One method employs loosely twisted rolls and another rolls without twisting. In both methods two, three, or four rolls as may be necessary, depending upon journal size, are applied with the ends tucked down at the side walls and no part of the packing extending above one inch below the center line of journal. These methods appear, when properly carried out, to result in a more nearly uniform application by the various box packers and according to reports, it has effected a noticeable reduction in the number of waste-grab cases.

Car Oil

Attention has been called to a number of axle journals found with pitted surface, particularly in the case of rolling stock that has been out of service for prolonged periods, making it necessary to machine-finish the journals before they are returned to service. The indications are that the pitting may be due to traces of acidity found in some mixtures of oil and waste, which, in the presence of moisture, forms a dilute acid which attacks

the steel journal. Some new car oils have been found to give an acid reaction and other car oils do not reflect such indication. It does not seem unreasonable to expect, under the present art of refinement, that all new car oils as well as renovated car oils shall be acid-free. One railroad system, and there may be others, rejects shipments of car oil on the basis of an acid reaction. Therefore, in the interest of taking steps to eliminate at least one cause for the development of pitted journals and to discourage a railroad from accepting an acid oil for use in interchange that another road has rejected, it has been recommended that Specification No. M-906-34, New Car Oil, be revised to contain a requirement showing neutral reaction to acid content.

It is well established that excessive water in journal boxes is a hazard to adequate lubrication, particularly in combination with dirt and other contaminations accumulated in service, and it is questionable that the demand for a water-free journal box assembly can be met within reasonable cost limits. Therefore, if any member has information to indicate that oils which separate almost instantly from water as contained in journal boxes are better lubricants than those which do not separate readily or vice versa, particularly in the presence of fine dirt, it would be helpful if such information could be furnished to the committee.

Waste

The quality of waste used for journal-box packing is a very important factor. Many roads use renovated waste in preparing packing for freight equipment. For passenger service all new, a mixture of renovated and new or all renovated waste is used quite successfully when the quality of the renovated materials are of a high order, in which case, in addition to the cleanliness of the waste, there is also the additional element of improvement due to the removal of the free lint and increased oil retention that renovated waste of this quality has over new waste.

Because of a wide divergence of opinions as to what constitutes a good grade of waste, the A. A. R. specification is necessarily broad, permitting many optional materials. Nevertheless, until such time as the range of grades can be narrowed to an acceptable standard, new waste should at least conform to A. A. R. Specification M-905-34.

Journal Bearings

Bearings with refinements in design, manufacture and finish known to be used in passenger service are those with lengthwise slots of various forms in the lining metal adjacent to edges for the purpose of trapping lint and waste strands; so-called "circulating," "vacuum," "self-cooling" and "oil-control" bearings provided with communications between the side slots through which excess oil passes, thereby aiding in the dissipation of bearing heat; milled back surface to insure a smooth bearing parallel with the broached journal surface and in addition to the milled surface, bearings with center depressions cast across the back are being used. This latter development is the result of tests which showed that even with a bearing with machined flat back there is a tendency for the bearing to warp under heat and produce a concentrated loading effect with the area which bears on the journal confined to the center. By virtue of the back center depression, the load on the journal is more evenly distributed through the full length of the journal bearing.

Wedges

In some instances, it has been the practice to reclaim wedges by reforging under a steam hammer, using dies for the purpose of restoring the convexity of the top surface and flattening the undersurface. This frequently produces unsatisfactory results.

A number of wedges have been found with the apex of the 78 in. radius crown coinciding with center line located at a point one-half the dimension of the overall length, which is one-half of dimension B shown on the wedge drawing or, in effect, a tapered wedge. This is contrary to the intent of the drawing which locates the apex of the crown at a point one-half the length of the surface that rests on journal bearing, or one-half of dimension A.

Despite the requirement in Rule 66 that the use of hollow-back or corrugated-back wedges is not permitted, such wedges have recently been found in service.

One road, and there may be others, has adopted the practice of machining the crown and the under face, also the back end, of wedges for passenger service. To reclaim wedges the surfaces are machined where necessary within limiting dimensions. This practice has resulted in restoring numerous wedges to passenger service that otherwise would have been diverted to freight or scrapped. Eventually such machined wedges will get into freight service.

Where machined-back journal bearings are used it is advantageous also to use a machined wedge.

The back end of wedges is commonly irregular and sloped due to the draft in dies. By using wedges with this end surface machined square with the under face, there has been a definite reduction in the number of broken bearing collars.

Journal Boxes

It is desirable that ceiling of journal boxes be flat; location and dimensions of stop lugs, and dust-guard well dimensions be in strict conformity with the A. A. R. requirements. Dust-guard well surfaces should be reasonably smooth; the lid hinge-pin lug should be in correct position and the flat machined or ground box mouth rim should be in proper position with respect to the center of the lug hole.

Badly worn hinge-lug contour can be restored by applying welding metal and grinding to proper shape. Worn lug hole can be restored to normal by welding and reboring or by securing a suitable steel bushing in place.

Dust Guards

The results of a survey made some time ago indicate that there is a need for substantial improvement in the dust guard. Although considerable study has been given to this complex problem, your Committee is not in a position to make definite recommendations with the view of adopting a more effective seal at this time. For freight equipment, the more effective sealing dust guards than the A. A. R. standard that are available are prevented from receiving favorable consideration because of their cost.

One member road, having in general use under passenger equipment a dust guard with a more effective seal, reports finding accumulation of water in journal boxes which was not found in boxes with less efficient dust-guard seals. However, the desirability of effectively sealing the back of the journal box against the loss of oil under extreme conditions of infiltration of water and dirt into the box is recognized as an improvement. With excessive water entering the front of the journal boxes, which was the case with boxes with dust guards tight enough to hold the water in, once it entered the box, the tight dust guard prevented the water floating the oil out the back of the box.

In roller-bearing boxes, the construction of which is relatively tight, water was also found by the same road which would indicate that it is a difficult problem to prevent the accumulation of moisture in a journal box.

In view of the importance of the problem, it is recommended as a minimum requirement that the top opening of the dust-guard well be sealed by plug or cap, provisions for which have already been adopted, and that well constructed dust guards, complying with A. A. R. requirements be maintained.

[The committee included a suggestion for a revised dust-guard specification M-903-34. New requirements in the proposed specification are that dust guards withstand submersion in water and in car oil separately at temperatures of 212 deg. F. for a period of 24 hours and specific reference to a number of defects from which the wood in dust guards must be free. Complete provisions regulating inspection, rejection, and rehearings have also been added.—Editor.]

It is recommended that the present Specification M-903-34 be continued in effect and that the foregoing suggested revision be circularized among the members of the Association with request that suggestions or criticisms be submitted for further consideration by the committee.

Box Lids

Attention is called to a requirement in Rule 66, paragraph 9, under the heading "Journal Boxes" to the effect that "when new journal boxes are applied, or when reapplying boxes, box lids complying with A. A. R. specifications shall be applied."

In connection with Specification M-120-35, covering the journal box lids, the committee has recommended that the outline of flat spring be deleted from the diagram shown on page 3 in order to avoid confusion with the requirement under par. 4 (b)

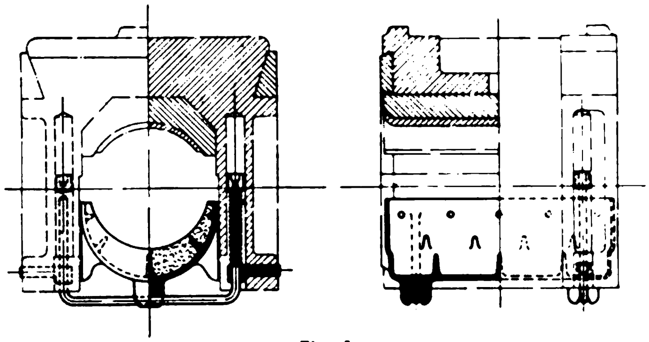


Fig. 1

which specifies "springs of the coil type to be used." This change will be made in the next revision of the manual.

As information, a few member roads are experimenting on passenger equipment with means for positively locking lids in closed

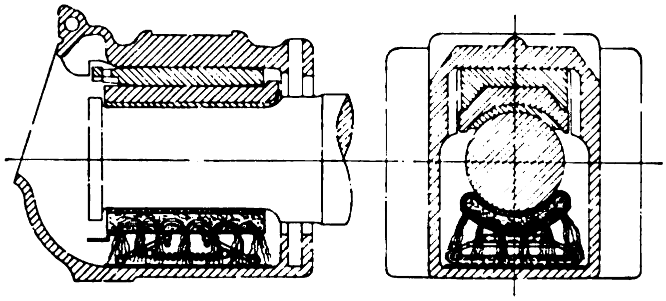


Fig. 2

position for the purpose of preventing vibration and to resist the raising of lids by ice formation between lid and box.

Axles

For this subject, including the finish and protection of journals, it seems sufficient to refer to the A. A. R. Wheel and Axle Manual which adequately covers all requirements thus far developed.

Truck Assembly

Details of design and mechanical condition of the entire truck assembly also have an important influence in acquiring successful lubrication performance. Observations of your committee and information coming to it indicate that control of lateral and the lubrication of the thrust bearing areas in conventional truck assemblies add to lubrication difficulties, particularly on roads having relatively numerous curves. That this is appreciated by one bearing manufacturer and by some roads experiencing increasing lubrication and maintenance troubles resulting from lateral is evidenced by activities during the past year in the modification of bearing and wedge design, and journal-box assembly tolerances with a view of controlling lateral thrust and wear, and improving service performance.

Your committee in this year's report has dealt with car oil, waste, bearing, wedge, box, dust guard, lid and axle details as

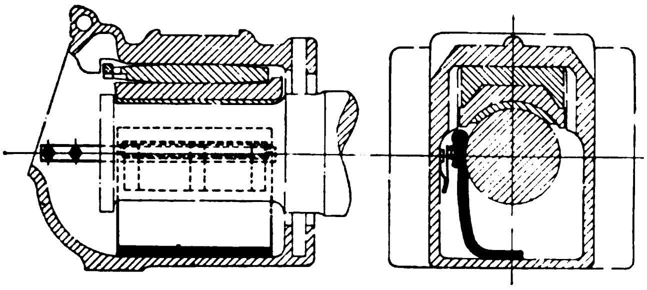


Fig. 3

separate items. It is of the opinion, however, that further improvement in journal performance through the correction of certain mechanical irregularities and changes in the design, manufacture, and maintenance tolerances of truck assembly details, which is not within its province, is a matter of sufficient importance to warrant study by a special joint sub-committee of members to be selected from the standing committees involved.

Pursuing the matter of steam and Diesel locomotive lubrication, your committee prepared a rather elaborate and all inclusive questionnaire which was forwarded to thirty-nine Class I railroads, which railroads operate in excess of 80 per cent of the locomotives owned by all class one railroads, in an effort to determine various practices and approach to standard in the matter of lubricating various wearing parts of the locomotive. Replies were received from 34 railroads and the results tabulated, which has permitted this committee to draw the following conclusions:

Lubrication of Steam-Locomotive Engine Trucks

In general, the common standard on all roads replying for engine-truck lubrication, consisted of oil-saturated waste contained in a cellar. In twenty-nine cases prints were furnished and indicated that this cellar was fixed; that is, a solid container for the waste was provided and held in the engine-truck box with various types of retainers, keys or bolts. Two roads reported that they were using the spring-loaded design of engine-truck cellar (Fig. 1). This cellar consists of a cast-iron shell equipped with prongs designed to prevent the packing rolling, and the shell is packed with oil-saturated waste and held against the journal by a combination of yokes and coil springs. The advantage claimed for this design is that, it insures contact between the packing and the journal at all times. There is a further advantage in ease of servicing or repacking.

Where the rigid cast-iron box cellar is used there are various methods of securing the cellar in place, generally by means of a tapered slot in the box, the taper usually approximately one in eight, which receives a corresponding rib on the cellar. The intent is to compress the packing gradually as the cellar is

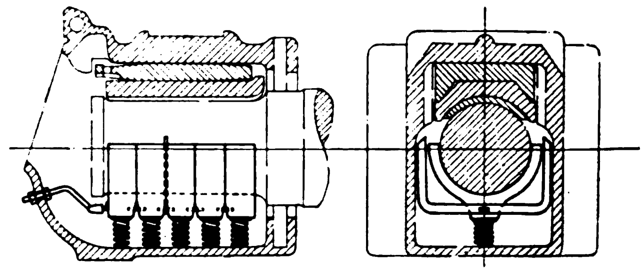


Fig. 4

forced into place. Many roads use a similar arrangement only with a horizontal tongue and groove.

There are a variety of methods of securing the cellars ranging from simple horizontal key bolts, diagonal key bolts and patented spring locks. Several roads indicated that they were using removable end plates in engine-truck cellars in order to facilitate servicing without removing the cellars. It was noted in such cases an oil well was provided in the cellar below the bottom opening of the end plate for retaining the oil.

The types of packing used range from one-hundred-per-cent wool waste to straight cotton packing. Two roads reported their common standard as a spring-loaded pad with feeders extending into an oil well in the bottom of the cellar with oil fed by capillary attraction (Figs. 2, 3 and 4); two roads reported oil and waste with auxiliary oiling from force-feed lubricators.

Practically all of the roads reported that engine-truck cellars are serviced each trip where oil and waste packing is used. A number of the roads reported that some special method of lubrication is provided for the engine trucks, such as spring-loaded pads (Fig. 2), a pad fed by an individual oil pump; the use of an air-actuated hand-operated pump and oiled waste (Fig. 6) or other mechanical force-feed lubrication for engine trucks. Twelve roads reported the use of roller bearings of several different designs on engine trucks.

While the vast majority of locomotives appear to be lubri-

cated with the waste-packed cellar, the efforts being made to improve lubrication, improve performance and reduce servicing costs, gives evidence that a change is generally desired.

In considering engine-truck lubrication the committee finds that there is a variation in practice as to application of lubrication. While it is generally applied to the cellar or waste packing, some roads still free-oil through a cavity in the top of the bearing. A number of roads have reported the use of specially designed so-called circulating bearings or lining of special composition as submitted by various manufacturers, but the extent of the use, considering the group of roads investigated, is not sufficient to permit of a conclusion.

There is a trend towards application of roller bearings to new power and the use of mechanical lubrication to oil-saturated waste in existing engine-truck installations.

Trailer Trucks

A summary of the replies with reference to standard design and practice for lubrication of trailer trucks in general corresponds with the information furnished covering engine trucks.

The standard practice for either outside or inside bearings appears to be a fixed cellar with oil-saturated packing with about the same variation between the grade of packing used as was evidenced in the survey of engine trucks. There appears to be less attempt to employ force-feed lubrication for adding oil to the cellar or packing than with the engine trucks.

Four roads reported the use of roller bearings on trailer trucks; seven roads reported a special type of lubricator, either a pad fed by an individual oil pump or several types of spring-loaded pads.

The most conclusive report on other than waste packing comes from one road which reported the adoption of a spring-loaded pad as a standard on heavy freight and passenger locomotives. They reported 103 passenger locomotives and 128 freight locomotives so equipped and advised that the service has been entirely satisfactory after a total operation of 52,000,000 locomotive miles.

Two roads reported rather extensive use of pads (Fig. 5),

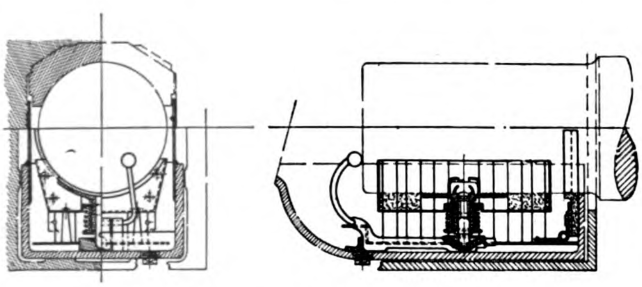


Fig. 5

fed by individual oil pumps, one road on 48 passenger and another on 78 passenger and 180 freight locomotives. One road reported satisfactory service and the other generally satisfactory service except for some breakage of parts and entrained dirt that stops up the oil passages.

Driving Journals with Oil Lubrication

From the replies made to the questionnaire there is evidence of an increasing tendency to substitute oil lubrication to driving journals in place of grease. Thirteen roads reported the use of oil lubrication in one form or another, exclusive of those utilizing roller bearings in this location. Four roads reported on nineteen applications of pads (Fig. 5), fed by individual oil pumps. Two roads reported on 162 locomotive applications (42 of these on all journals except main), of a spring-supported pad (Fig. 2). These applications have been made to locomotives in both freight and passenger service and satisfactory service has been reported on speeds in excess of 75 miles per hour in passenger service and 50 miles per hour in freight service for the above applications.

One road reported on force-feed lubrication of valve oil on a Pacific type passenger engine which is under test. Another road reported installation of waste-packed cellar, similar to engine truck, to a switch engine in November, 1937, for test purposes, and apparently the service to date has been satisfactory. Three

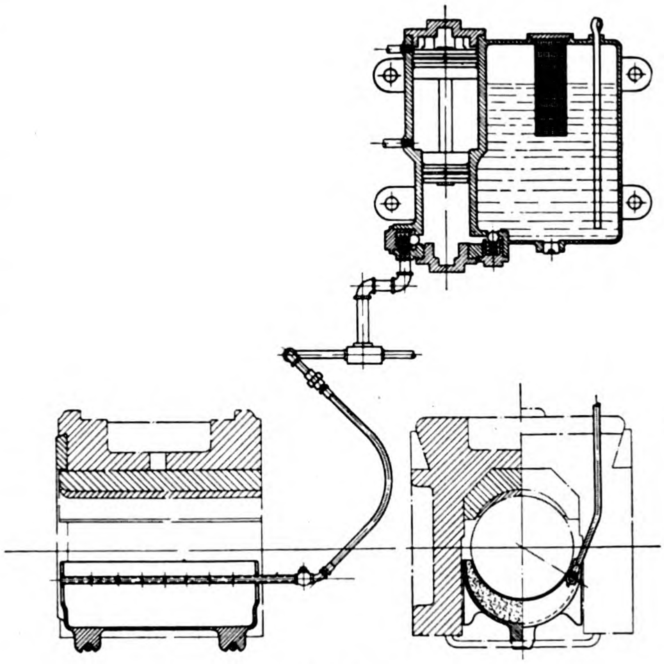


Fig. 6

roads reported on 54 locomotive applications of waste-packed cellars similar to engine and trailer trucks, and 46 of these locomotives are in slow speed heavy freight service.

There is a new development on the market, and now under test (Fig. 7). This incorporates a floating axle flooded in oil by a pump actuated from the movement of the locomotive and running in a bronze bushing, and a lateral device consisting of a collar forged into the center of the axle to which wear resisting plates are opposed and, like the journal bearing, flooded in oil. This, in effect, is a full floating axle. In view of the interest indicated in application of oil lubrication to locomotive driving journals, this device holds interesting possibilities, although to date tests have not progressed sufficiently to indicate the ultimate results that may be obtained.

Pump-fed and spring-loaded pads have undergone a rather wide range of tests. Some difficulties have been reported due to broken springs resulting in failure to keep the pad of either device against the journal, but in general the service has been quite satisfactory and apparently the difficulties are being gradually overcome.

Your committee recommends further study of the application of oil lubrication to locomotive driving journals for the reason that in addition to reduced friction through the use of oil in place of grease for journal lubrication, there is the advantage of lower operating temperature, less liability to stuck wedges and the possibility of diverting a portion of the journal lubrication to regularly and consistently lubricate shoe, wedge and lateral bearing faces.

Lubrication of Engine- and Tender-Truck Center Plates

Evidence of the interest devoted to improving lubrication of engine- and tender-truck center plates is evidenced by the fact that, of the 34 roads reporting, eighteen roads reported efforts to lubricate this bearing by other methods than the application of lubrication at various times when the castings are separated

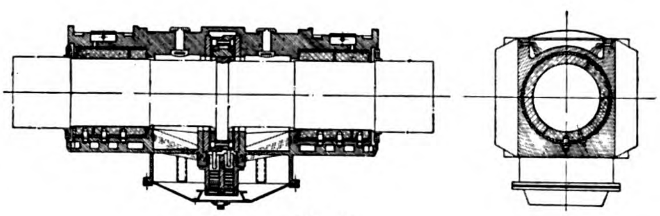


Fig. 7

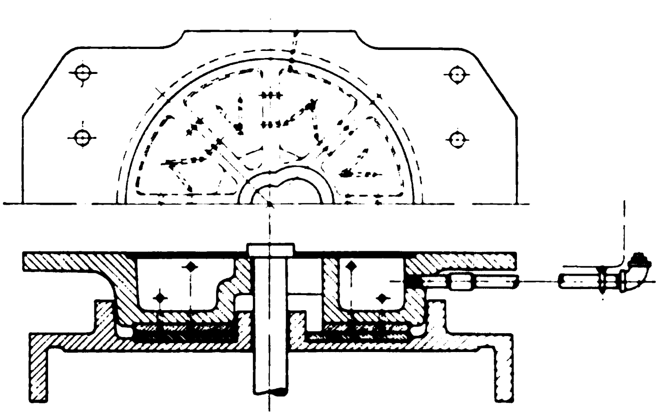


Fig. 8

by jacking, including soft-grease lubrication; oil cups; mechanical force-feed lubrication; bronze or hardened-steel wearing plates drilled for oil distribution, and the oil piped to enclosed cavities in the castings (Figs. 8 and 9).

Eighteen roads reported on the use of soft grease applied with a pressure gun to various systems of grooving which is used more extensively than any of the other improved systems reported upon, and from the reports of reduction in wear appears to be satisfactorily serving the purpose.

Radial-Buffer Lubrication

Twenty-four of the roads replying to the questionnaire indicated that they are using a different method of lubricating radial buffers other than hand oilers. All of the roads, with the exception of two, were using a soft grease applied from a pressure gun, and four roads reported the use of oil lubrication from special containers or from mechanical lubricators using splitters on some engines and soft grease on others. The use of soft grease has been standardized on at least eight roads, and one road uses crude oil.

Those who estimated a reduction buffer in wear were agreed on a fifty per cent reduction. In this connection, a number of roads have employed the use of a shield above the chafing casting in addition to the lubrication, in an effort to exclude coal dust and foreign particles from the wearing surfaces.

Drifting Valves

Fifteen roads out of thirty-four are using drifting valves on 1,842 locomotives. They indicated that the purpose of applying these drifting valves was to provide distribution of lubrication to valves and cylinders, while the locomotive was drifting, to reduce formation of carbon and provide some compression for cushion of reciprocating parts while drifting, and the replies for the individual roads vary from one locomotive on test to 316 locomotives in regular service.

Ten roads indicated definitely that the device had served the purpose of improving lubrication and reducing the formation of carbon. One road reporting on 283 drifting valves and 12 by-pass valves indicated the by-pass valves had functioned entirely satisfactorily, but the drifting valves had not proven entirely satisfactory when drifting at high speeds.

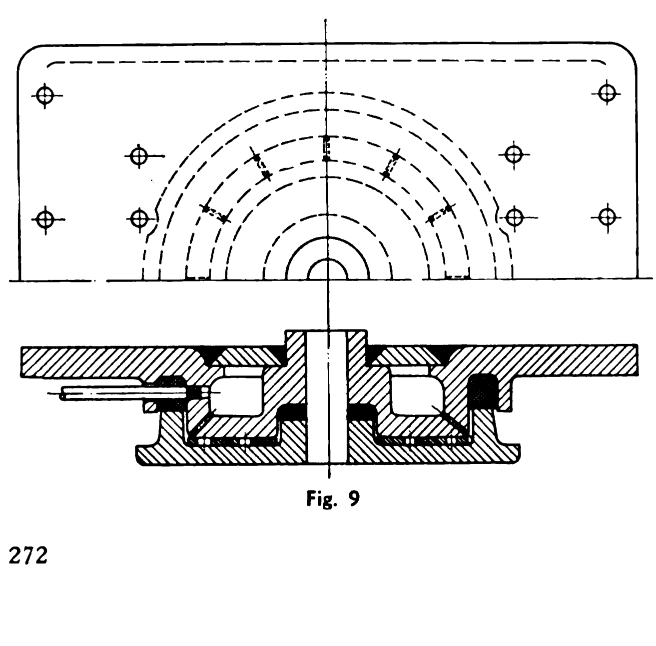


Fig. 9

In answer to the question as to fuel saving, four roads reported no record; one road, operating 240 locomotives, indicated a doubtful saving, and the balance indicated they have found a saving in fuel.

Material for Valve and Cylinder Bushings

The summary of the reports indicates the tendency to get away from common gray iron castings for these important wearing surfaces. There are a number of tests of materials which hold considerable promise and which tests have not proceeded sufficiently far to justify extensive installation.

One road reported on a material with the trade name Meehanite, which material is susceptible to heat treatment, and in the heat-treated condition has superior physical qualities as compared with ordinary gray iron. The tests of these bushings in the heat-treated state have indicated possibilities of satisfactorily using this material for bushings.

The use of sectional piston packing was reported by all roads except two and has been adopted as standard on many of the larger roads representing the majority of the locomotives from the roads reporting. The use of sectional valve rings is less general than the use of sectional piston rings. Reports show approximately fifteen per cent as many locomotives equipped with sectional valve rings as were equipped with sectional piston rings, however, use has become quite general as evidenced by the fact that twenty-two of the thirty-four roads reporting reported the use of sectional valve rings on certain locomotives, or they have standardized on the sectional valve rings or have extensive tests under way.

Invariably the reports indicated that there was considerably increased life from the sectional valve and piston rings, ranging from 100 to 250 per cent.

Methods of Lubricating Engine-Truck, Driver and Trailer Hubs

The reports indicate that the necessity of ample lubrication of these parts is appreciated and that some method other than the hand oiler is desirable. This is evidenced by the fact that practically all railroads replying indicated one of many various methods, ranging from the hand oiler in the hands of the engineer, crater compound and soft grease applied at engine terminals with a paddle, and to the use of valve oil applied through force-feed lubricators.

A number of the roads reported on the use of soft grease applied by means of a pressure gun and special fittings to cavities drilled through the hub of the wheel, and they indicated that this arrangement is quite satisfactory.

With the advent of the various types of dividers or splitters now available for use with force-feed lubricators, many locomotives of recent design, as well as heavy locomotives as they pass through the shop, are being equipped with these dividers which insure a regular distribution of engine oil, or equivalent oil, to the various hub-liner faces as well as to other bearings, and since the regularity of the application of lubricant is greatly to be desired it appears to your committee that any of the various methods of accomplishing this through the use of force-feed lubricators is deserving of serious consideration, and especially so on locomotives on long engine runs. Such applications properly maintained should pay good dividends in trouble-free performance, elimination of servicing enroute as well as reduction of lateral wear.

Method of Lubricating Guides

The replies received indicate the necessity for improved lubrication to locomotive guides. While the syphon oil cup, or oil cups equipped with a wick feed largely predominate on the older types of locomotive, the modern locomotives and locomotives under heavy duty in high-speed service are being rapidly equipped with force-feed lubrication. Apparently many of these applications have been made in an effort to use existing lubricators since a number of the roads are using valve oil through dividers to lubricate the guides. Other locomotives that are equipped with a second engine lubricator are using engine oil

on the guides as well as other wearing parts of the locomotive. However, practically all of the roads indicated that the force-feed method is most efficient and satisfactory.

Method of Lubricating Shoes and Wedges

Many locomotives have no provision for lubricating shoes and wedges other than hand oiling usually through waste pockets in the top of the box which are saturated with oil with the hope it will find its way through various passages and grooves to the face of shoes and wedges. The deficiency in this system and the principal objection to it is the fact that its success is dependent first, upon terminal forces to maintain the waste pads and, second, upon the attention given by the enginemen at initial terminal and enroute.

A large number of locomotives have been equipped with grease cavities to which soft grease is applied by the use of a pressure gun. This method is generally considered superior to hand oiling as evidenced by the fact that at least ten roads out of the thirty-four have indicated this system as their preference over hand oiling. There are objections to the use of soft grease; first, due to the tendency of terminal forces to apply an excessive amount and, second, the tendency on the part of the grease to increase its flow, sometimes in excessive amounts, after driving boxes reach a normal running temperature.

The extension of lubrication to these parts by means of force-feed lubricators through the use of dividers is increasing. On the majority of locomotives of recent construction, and particularly those with roller bearings, the mechanical lubricator has been generally adopted.

Specifications of Diesel Crank Case Oil

There is considerable range in the specifications of crank-case oil used by those roads operating Diesel-powered high-speed main-line trains, the majority using such an oil approximately of the specifications SAE 50. It is evident that many of them purchase oil for this purpose by brand.

Those roads operating locomotives in switching service also use a wide range of crank-case oil, but generally an oil somewhat heavier than SAE 50, with a tendency to vary the pour point between summer and winter, depending upon the territory in which the operation is carried on.

The practice as to mileage between oil changes is as varied as the source of supply. In road service the railroads reported oil changes ranging from 2,500 miles to 10,000 miles, and in yard service from three months to 25,000 miles. This wide variation may be explained in part through the use of continuous type filters located upon the unit in some cases, and in other cases upon the nature of the service performed.

In view of the claims of the damaging effect of acidity in crank case oil, the committee's questionnaire was designed to develop any troubles from this source and the method of correcting same. The thirteen roads operating Diesel engines advised they had experienced no difficulties traceable to acidity in crank-case oil. One or more roads advised they had arranged their oil changes in order to avoid development of acidity and apparently had been successful.

Lubrication of Armature Bearings

Armature bearings seem to be quite distinctly divided, with roller or ball bearing predominating on locomotives in road service, and waste-packed friction bearings on locomotives in yard service, although a number of roads reported roller or ball bearings on switch engines.

The servicing period for the ball or roller bearings vary with the service requirements. In general the grease cavities are filled to approximately half their capacity when the unit is placed in service; thereafter the pinion end is lubricated with from four to eight ounces of grease at intervals of from 4,500 to 23,000 miles. The armature end is lubricated with from four to twenty-four ounces of grease at intervals of approximately 20,000 miles. In general a good grade of ball-bearing grease is used, usually a brand recommended by the bearing manufacturer.

In switching service invariably long-strand wool waste is used for packing, and the grade of lubricant used varies from SAE 30 to a mixture of fifty per cent car oil and fifty per cent crank-case oil and various oils apparently purchased by brand.

Method of Lubricating Axle-Cap Bearings

Axle cap bearings are uniformly lubricated by the use of long-strand wool-waste wick held securely against the journal by means of balls of waste and in many cases additional pressure is applied against the wick by means of a loaded steel plate to insure packing against jarring or shaking away from the journal. This practice is in accord with the various motor manufacturers' recommendations.

Two roads reported having experimented with force-feed lubrication to the oiled wick to insure ample lubrication at all times. There is no evidence that this practice is being extended. The greatest variation in the practice of lubricating axle cap bearings appears to be in the service period. Some inspect and reservice each trip and others on thirty days' inspection.

That the type of bearing and service obtained from the method of lubricating axle cap bearings has been entirely satisfactory can be based upon the replies of twelve of the thirteen roads reporting on operation of Diesel units to the effect that they had experienced no difficulty and had no recommendations for improvements; the remaining road failed to answer this question.

The report was signed by E. L. Johnson (chairman), engineer of tests, New York Central; H. P. Allstrand, principal assistant superintendent motive power, Chicago & North Western; J. R. Jackson, engineer of tests, Missouri Pacific; P. Maddox, superintendent car department, Chesapeake & Ohio; and A. J. Pichetto, general air brake engineer, Illinois Central.

Discussion

The first speaker during the discussion suggested the idea of ribs being welded in the car journal boxes to keep the waste down in the lower portion of the box, and requested that other roads try this arrangement. The next speaker stated that pressure grease lubrication of center plates had not been found entirely satisfactory, but that oil, using the same piping arrangement as with grease and with a suitable seal, was providing satisfactory lubrication.

Two other speakers, discussing the lubrication of Diesel engines, stressed the importance of maintaining a clean air supply to the engine by the use of suitable filters and the last speaker made the comment that the successful lubrication of Diesel engines depends, to a great extent, upon filters and cooling equipment. On the road that he represents the practice has been adopted of taking weekly samples of oil from the crank cases of all Diesel engines and sending them to the laboratory for analysis. It has been found that the viscosity and precipitation number are the most important elements in the analysis, and that, as a result of this practice, it has now become possible, on one class of Diesel-electric locomotives, to limit the oil changes to one each twelve months, subject, however, to the weekly laboratory analysis.

(The report was accepted.)

Report of Arbitration Committee

With the approval of the Operating-Transportation Division, no extension beyond January 1, 1940, is recommended for requirement in Paragraph (a-6) of Rule 3, prohibiting acceptance of cars in interchange bearing advertisements of any shipper, consignee or product. The wording of this paragraph has also been revised to harmonize with Operating-Transportation Circular No. T-55 dated April 19, 1939, making an exception of special cars of Mechanical Designation "L" and tank cars of Mechanical Designation "T."

The requirement in Paragraph (r-3) of Rule 3 which provides that hatch covers be secured with hinges on refrigerator cars, has been in the rules since August 1, 1930. No requests for extension of effective date beyond January 1, 1940, have been received. The committee feels that sufficient time has elapsed to permit compliance and that, in the interest of safety, no further extension of effective date is justified.

In accordance with proviso attached to approval of extension of effective date of Paragraph (t-17) of Rule 3 to August 1, 1939, specifying that plugs in heads of tank cars must be of solid type in order to comply with I. C. C. Specification No. 103, no further extension is recommended.

As result of complaints from various railroads and railroad clubs as to excessive defect carding for minor damage, including submission of hundreds of defect cards which had been outlawed without repairs having been made, an investigation and field study has been conducted under the direction of the committee. A revision of Rule 4 is recommended which it is felt will eliminate much of the excessive carding for minor damage, clarify the rule and set up more definite limits for the guidance of car inspectors.

A new interpretation is added to Rule 4 to provide that carding company be granted the option of participating in joint inspection on cars damaged extensively by fire or flood and sent home bearing defect cards containing general statement of damage without specifying detail defective parts.

Upon recommendation by the Committee on Couplers and Draft Gears and with the concurrence of the Committee on Car Construction, Rule 20 is revised to provide for proper alignment of couplers and draft gears in connection with adjustment of coupler height.

The permissible re-light-weighing period is eliminated from Rule 30. Investigation developed that many foreign cars were being shopped for re-weighing immediately upon expiration of the 24-month permissible period. It is felt car owner should have the opportunity to re-weigh his own equipment prior to expiration of the 30-month period. As result of recommendation by your committee to the Operating-Transportation Division, this change has been submitted to letter ballot of that Division's members and approved.

Interpretation No. 9 to Rule 32 is modified to eliminate defect carding for minor damage caused by pulling with hook and cable.

The matter of establishing separate rates for and dates from which depreciation is to be computed for tanks, underframes and trucks of tank cars, for settlement purposes for destroyed cars, has been investigated by a joint subcommittee of representatives of the Arbitration and Tank Car Committees. A modification of Rule 112 is recommended to provide for separate depreciation of tanks of tank cars from date originally built, with no change in depreciation rates or limits, which it is felt affords a more equitable settlement basis. Provision is also incorporated to permit car owner to secure return of serviceable tanks from such cars, if desired.

The committee does not feel that any of the modifications included in its report necessitate submission to letter ballot.

All recommendations for changes in the Rules of Interchange submitted by members, railroad clubs, private car owners, etc., have been carefully considered by the committee and, where approved, changes have been recommended.

Attention is again directed to the fact that the Arbitration Committee will not consider questions under the Rules of Interchange unless submitted in the form of Arbitration Cases as per Rule 123.

Freight-Car Rule 3

The committee recommends that effective dates for various requirements in the present rule, as listed below, now set at January 1, 1940, be extended to January 1, 1941:

Section (b), Paragraph (8)—Bottom rod and brake beam safety supports.

Section (b), Paragraph (9)—Braking power.

Section (b), Paragraph (10)—Brake shoes.

Section (c), Paragraph (11)—Couplers having 5-in. by 5-in. shanks.

Section (j), Paragraph (2)—Journal boxes, repacking of.

Section (t), Paragraph (3)—Welded side frames having T- or L-section compression or tension members.

Section (u), Paragraph (4)—Class E-3 cars not to be accepted from owners.

Also, that the effective date of Paragraph (7) of Section (b) of this rule, having reference to metal badge plate showing dimensions of brake levers standard to car, now set at January 1, 1940, be extended to January 1, 1942.

Reason: The present situation justifies these extensions.

The committee recommends that no further extension beyond August 1, 1939, be granted for effective date of requirement contained in Paragraph (17) of Section (t) of this rule, requiring that plugs in tanks of tank cars must be of the solid type, and that the wording be modified and revision included in the next supplement, as follows:

Proposed Form: (t-17) Tank cars (empty or loaded): Effective August 1, 1939, plugs ***in heads of*** tank cars must be of the solid type, etc.

Reason: Extension to present effective date was approved with proviso that no further extension would be granted due to the fact the provision was incorporated in the 1938 Code as a safety measure to comply with I. C. C. Specification No. 103. Requirement modified to apply only to plugs in heads of tank cars, as recommended by the Committee on Tank Cars.

The committee recommends that the last two sentences in Paragraph (4) of Section (a) of this rule be modified and revision included in the next supplement, to require reports to the A. A. R. by car owners semi-annually instead of quarterly.

Reason: It has been agreed that semi-annual reports will suffice for the purpose. Notice of change in this requirement was transmitted to all car owners on April 8, 1939, and no request was submitted for data covering the first quarter of 1939.

The committee recommends that Paragraph (3) of Section (s) of this rule be modified, effective August 1, 1939, as follows:

Proposed Form: (s-3) Stenciling: Date built new, month and year, or badge plate giving this information, required on all cars. Date rebuilt, in addition to date built new, month and year, or badge plate giving this information, required on all cars rebuilt on or after July 1, 1928. From owners: ***In event tank and underframe of tank car are built at different times each must bear distinctive dates, the date on underframe to be date car was originally built.***

Reason: To harmonize with change in Paragraph A-5 of Rule 112.

The committee recommends that Paragraph (3) of Section (u) of this rule be modified as follows:

Proposed Form: (u-3) Underframe, etc.: No car of all-wood underframe equipped with metal draft arms extending 24 inches or more beyond center line of body bolster, will be accepted. ***In interchange.***

Reason: Definition of Class E-4 car will be eliminated from Rule 112. It is felt sufficient time has elapsed to make this provision a general interchange requirement.

Rule 4

The committee recommends that Section (a) of this rule be modified and Interpretations Nos. 2 and 6 eliminated, as follows:

Proposed Form: Rule 4. (a) In the case of damage to a car for which the delivering line is responsible, such line must at the first available inspection point, attach defect card to cover. On cars extensively damaged which are forwarded home for repairs, the defect card, in addition to the defects noted, shall bear notation "Home for repairs." ***This notation shall be applied only by the company issuing the defect card. No alterations may be made to defect card except by company issuing same or in cases of partial repairs as outlined in Rule 5. Defect cards cannot be repudiated.*** If only a portion of the unfair usage damage is repaired, defect card ***for the remainder of such damage*** must be applied ***prior to release of car.***

Reason: It is immaterial whether the partial repairs are made in shop or elsewhere and it should be clear that only the unrepaired portion must be carded. Last sentence modified and transferred to Paragraph (b-2) which deals with carding in interchange.

The committee recommends that Section (b) of this rule be modified as follows:

Proposed Form: (b) (1) Slight ***unfair usage*** damage that of itself does not require repairs ***to make car serviceable is not cardable, whether or not associated with other cardable damage. Items damaged to a lesser extent than specified in Sections (c) to (h), inclusive, are considered as slight damage within the meaning of this paragraph.***

(2) If cars are offered in interchange with damage other than referred to in Paragraph (b-1), on which there is conclusive evidence of unfair usage, the receiving line shall require that defect card be attached to car, per Rules 2 and 14. Damage to or beyond extent specified in Sections (c) to (h), inclusive, will be classified as unfair usage for which defect card shall be issued in interchange.

Reason: It is felt slight damage, whether caused by fair or unfair usage, which does not require repairs to make car serviceable, should remain the responsibility of car owner regardless of any other cardable damage on car: To clarify the intent and set up definite limits for the guidance of car inspectors regardless of cause of damage.

The committee recommends that Section (c) of this rule be modified as follows:

Proposed Form: (c) House Cars, All-Steel and Outside Steel Frame:

(1) Metal posts, metal braces and metal sheets: Cut through the thickness of the metal. *Post and brace* flanges only, cut through, will not be cardable.

(2) *Metal posts, metal braces and metal sheets*: Bent inwardly 1½ inches or more. Bulb portion only of pressed-steel parts, or flanges only *of structural shapes*, when bent, *regardless of extent*, will not be cardable except where necessary to repair under conditions referred to in Paragraph (3).

(3) *Metal posts, metal braces and metal sheets*: Bent inwardly less than 1½ inches, *when* necessary to repair for proper operation of door, or to comply with Safety Appliance requirements, or to restore alignment of bolt holes, rivet holes, or joints for welding.

Reason: To clarify the intent and harmonize with change in Paragraph (b-1). Metal slats omitted account practically none in use on house cars.

The committee recommends that a new sentence be added to first note following Section (d) of this rule and Interpretation No. 4 eliminated, as follows:

Proposed Form: Note.—It is understood that adjoining raked sheathing if not split or broken will not be cardable unless raked into tongue, except that on refrigerator cars sheathing boards raked to bottom of bead but not into tongue will also be cardable if they adjoin (in consecutive order) the board raked into tongue, broken or split. *Sheathing damaged due to use of bar for closing side door is not cardable.*

Reason: To eliminate Interpretation No. 4.

The committee recommends that Section (f) of this rule be modified as follows:

Proposed Form: (f) Open-Top Cars.

(1) Metal posts, metal stakes, metal braces, metal top chord angles, or their substitutes: Bent inwardly *four* inches or more. Bulb portion only of pressed steel parts, *or* flanges only *of structural shapes*, when bent, *regardless of extent*, will not be cardable except where necessary to repair under conditions referred to in Paragraph (2).

(2) Metal posts, metal stakes, metal braces, metal top chord angles, or their substitutes: Bent inwardly less than *four* inches, but necessary to repair for proper operation of door or gate, or to comply with Safety Appliance requirements, or to restore alignment of bolt holes, rivet holes, or joints for welding.

(3) Metal *side and end* sheets: *Holes* through the thickness of the metal to an extent exceeding three inches *measured in any direction, except when due to corrosion.*

(4) (No change.)

(5) *Metal top chord angles or their substitutes*: *Holes exceeding 1½ inches measured in any direction.*

(6) *Flat car floors; metal or wood*: *Holes cut, exceeding three inches in any direction*, except wood floors having holes not exceeding 3 by 12 inches each (latter dimension lengthwise of car) for center pin of pivoted load bolsters.

Note.—Holes in cars due to change in construction, or parts cut out to provide clearance for safety appliances, are not cardable.

Reason: To eliminate excessive defect carding for minor damage.

The committee recommends that Section (g) of this rule be modified as follows:

Proposed Form: (g) (1) All cars: Metal and sill, *damaged in unfair usage, when removal from car is necessary for any repairs to car.*

(2) All cars: Metal side sills, extending from bolster to end sill only, if flange or web is bent in excess of *2½* inches.

(3) (No change.)

Reason: To clarify the intent and eliminate excess wording. Dimension for bent side sill modified to 2½ inches, to harmonize with Rule 44.

The committee recommends that first paragraph of Section (h) of this rule be modified by omitting reference to *present* head-block anchorage.

Reason: To clarify the intent, as tank cars having head-block anchorage are no longer permitted in interchange service.

The committee recommends that third paragraph of Section (h) of this rule be eliminated.

Reason: Cars with defective safety appliances cannot be interchanged under Rule 2. This requirement relocated in Rule 33.

The committee recommends that a new note be added to Section (1) of this rule and Interpretation No. 5 eliminated, as follows:

Proposed Form: (1) *Note.—All associated defects should preferably be recorded on information card. However, if this is not done, the existence of such additional defects shall be established by joint inspection certificate executed at home shop as outlined in Section (k) of this rule within 90 days after first receipt of car by owner. In the event Rule 44 damage cannot be established as owner's defects, defect card shall be issued by the company issuing the information card for all associated defects as well as the Rule 44 damage.*

Reason: For better reference.

The committee recommends that a new interpretation be added to this rule, to become effective August 1, 1939, to read as follows:

Q.—Where defect cards read "Car in flood" or "Superstructure damaged by fire," or other similar general statement of damage without specifying defective parts, whether or not containing notation "Home for repairs," is car owner required to have joint inspection made and apply for detailed defect cards per Section (k)?

A.—In such cases where whole or part of superstructure is involved through general statement of damage, car owner must accord railroad issuing defect card the opportunity of participating in joint inspection, whether or not a chief interchange inspector is employed in such inspection. If railroad issuing such defect card fails within 15 days from date of notification to avail itself of the opportunity of making joint inspection, then the joint inspection shall proceed in the manner prescribed in Section (k).

Reason: It is considered the provisions of Section (k) as to joint inspection can reasonably be extended to cars extensively damaged in flood or by fire and that carding company should have the option of participating if desired.

Rule 9

The committee recommends that third item in this rule with respect to information that must be specified on billing repair cards in connection with "Periodic Repacking of Journal Boxes," be modified as follows:

Proposed Form: Purpose for which car was shopped, *if repacked prior to expiration of 15 months.*

Reason: This information is unnecessary on cars repacked after the 15-months limit has expired.

The committee recommends that sixth item in this rule be modified as follows:

Proposed Form: Brake shoe keys, applied: 1934 A. A. R. Standard, *or the symbol* "K-34," must be shown to justify charge.

Reason: To clarify the intent.

Rule 17

The committee recommends that last column opposite Item No. 5 in the brake-beam substitution table appearing in Section (e) of this rule be modified, by the addition of a last clause, to read as follows:

Yes. Issue defect card for labor and material *whether or not No. 2-plus beam is standard to car.*

Reason: To clarify the intent and eliminate confliction with No. 5.

Rule 20

The committee recommends that second paragraph of this rule be modified as new Paragraphs (b) and (c), a new last Paragraph (f) and new Figures 1, 2, 3 and 4 added and interpretation eliminated, effective August 1, 1939, as follows:

Proposed Form: (b) *When adjusting coupler heights under*

the provisions of Paragraph (a), the coupler should first be placed in proper alignment with draft gear. Shim as shown in Figures 1, 2, 3 or 4 [*The drawings referred to are not included*—Editor] *of ¼-inch thickness or more as required, may be applied for this purpose. If shim less than ¼-inch thickness is required, re-alignment is unnecessary.*

(c) After coupler has been placed in proper alignment by shimming carrier, if its height is not at least ½ in. in excess of minimum dimensions specified in Paragraph (e), further adjustment should be made at the truck springs, center plates or journal boxes.

(f) When couplers or draft gears are removed, replaced or renewed for or on account of repairs, and coupler height is within prescribed limits, the couplers and draft gears should be properly aligned as provided in Paragraph (b).

Reason: To provide for proper alignment of couplers and draft gears in connection with adjustment of coupler height, as recommended by the Committee on Couplers and Draft Gears and with the concurrence of the Committee on Car Construction.

Rule 23

The committee recommends that Section (g) of this rule be modified as follows:

Proposed Form: (g) When truck side frames, bolsters and knuckle-tail back wall of coupler heads are welded, the following record must be legibly stamped on the weld *or immediately adjacent thereto* by at least ⅜-in. steel stencils, in the following form:

(No other change.)

Reason: In some cases it is impractical to apply the stencil on the weld and stamping same immediately adjacent to the weld should suffice.

Rule 30

The committee recommends that Paragraph (1) of Section (B) of this rule be modified effective August 1, 1939, by eliminating the "wood" type of car and last column reading "Subsequent reweighing permissible after 24 months" be changed to 30 months.

Reason: To harmonize with change in Car Service Rule 11, as approved by letter ballot of the Operating-Transportation Division.

Rule 31

The committee recommends that Paragraph (b) of this rule be modified, effective August 1, 1939, as follows:

Proposed Form: (b) Where weight of car is changed 300 lb. or more (for refrigerator cars 500 lb. or more) account repairs of delivering company's defects, the expense of relight-weighing and re-marking will be charged to party responsible for such defects, unless *car is due for re-weighing per Paragraph (1), Section (B) of Rule 30.*

Reason: To harmonize with change in Rule 30.

Rule 32

The committee recommends that caption preceding this rule be modified as follows:

Proposed Form: Parts of Cars Which Justify Repairs If Owners Are Responsible, or Repairs or Carding If Delivering Company Is Responsible, *Except As Otherwise Provided For In Rule 4.*

Reason: To avoid confliction with Rule 4.

The committee recommends that Section (6) of this rule be modified as follows:

Proposed Form: (6) Removing parts or burning out parts of car to facilitate loading, unloading or for other purposes.

Reason:. Account change in Rule 4 which covers.

The committee recommends that Interpretation No. 9 to this rule be modified, effective August 1, 1939, as follows:

Proposed Form: Inter. (9) Q.—Who is responsible for damage to car caused by pulling with hook and cable?

A.—Car owner, except where damage is such as to prevent side bearing from functioning or where body bolster or crosstie is pulled entirely away from side sill.

Reason: To eliminate excessive defect carding for minor damage.

Rule 33

The committee recommends that Paragraph (3) of Section (b) of this rule be modified as follows:

Proposed Form: (3) Safety appliances on tank cars where damaged under any of the provisions of Rule 32, *including safety railings, handholds, sill steps, ladder treads, and their brackets or supports, also running board supports when bent so that safety appliances are beyond clearance limits prescribed by I. C. C. Safety Appliance Acts.*

Reason: Transferred from Rule 4.

Rule 64

The committee recommends that second paragraph of this rule be modified as follows:

Proposed Form: No charge shall be made for application of separate common nuts unless such nuts are fully tightened, and, where applied to journal-box bolts, column bolts, brake-hanger bolts, carrier-iron bolts, *or coupler and draft-gear support bolts,* such common nuts must be secured with nut lock or lock nut.

Reason: As a safety measure.

Rule 98

The committee recommends that reference to Rule 73-A and 83 be eliminated from Paragraph (4) of Section (c) of this rule.

Reason: To eliminate confusion in billing.

The committee recommends the addition of a new first note following Section (g) of this rule, and that present note be relocated as a new second note and modified by addition of new last clause, to read as follows:

Note 1.—Gage readings for multiple-wear wrought-steel wheels removed and applied, when the "after turning" measurements are predetermined by Standard wrought-steel wheel gage, must be reported at top of wheel-and-axle billing repair cards as per following example:

	(1)	(2)	(3)
(One wheel)	*2¼ in. — (minus)*	*¾ in. — (minus)*	*9⁄16 in.*
(Mate wheel)	*2 3⁄16 in. — (minus)*	*¾ in. — (minus)*	*3⁄16 in.*

to indicate for each wheel (1) tread thickness over all, (2) amount of metal between measuring point and condemning line and (3) amount of metal to be turned off as indicated by wrought-steel wheel-gage finger to produce full flange contour.

Note 2.—In the predetermination of service metal on wrought-steel wheels by use of the standard wrought-steel wheel gage, when neither wheel is scrap, the amount of metal required to be turned off the wheel suffering the greater amount of loss should apply equally to the mate wheel. When recording service metal of wrought-steel wheels on billing repair cards, the amount of service metal before and after turning, as indicated by steel-wheel gage, shall be shown for each wheel, *with the understanding that the amount of service metal after turning shall be determined by deducting the greater amount of loss on either wheel from the amount of service metal on each wheel before turning.*

Reason: To clarify the intent. It is also felt car owner is entitled to the gage readings to permit check of charges and credits.

The committee also recommends that the Wheels and Axles Billing Repair Card forms shown on pages 264 and 265 be modified to provide "Before Turning" and "After Turning" captions for wheels applied as well as removed.

Reason: Account change in Section (g) of Rule 98.

Rule 102

The committee recommends that last paragraph of this rule be modified as follows:

Proposed Form: In computing charges for paint, bolts, *nails,* nuts and forgings, if fractional weight of each entry on billing repair card is less than one half pound, it must be dropped; if one-half pound or more, charge the entire pound.

Reason: It is felt no charge should be made for this small amount of material.

Rule 111

The committee recommends that Item (8) of Paragraph (b) of Section 15 of this rule be modified as follows:

Proposed Form: (8) Vent protector. (Original application *may be charged only when periodic cleaning is performed.*)

Reason: Vent protectors should be applied in all cases when brakes receive periodic attention.

Rule 112

The committee recommends that Paragraph 5 of Section A of this rule be modified, effective August 1, 1939, as follows:

Proposed Form: (5) Age of car shall be determined by subtracting year and month in which car was originally built, or rebuilt, from year and month in which car was destroyed, which will give the life in years and months. No fractional part of a month shall be considered. The age of trucks shall be the same as that of the car body. *Where new or second-hand tank is applied to a tank car subsequent to original date car was built, depreciation on such tank shall be computed from date tank was built new, and depreciation on remainder of car shall be computed from date car was originally built.*

Reason: To afford equitable compensation in settlement for destroyed tank cars.

The committee recommends that reference to the Class E-4 type of car be eliminated from table of per pound prices in Section B of this rule, and note following this table modified, as follows:

Proposed Form: Note.—Cars with continuous metal draft sills of not less than 18 lb. per foot per member, without cover plates, where such continuous metal draft members are suitably tied to body bolster, are equivalent to *Class E-3* for settlement purposes.

Also, that similar modification be made in Paragraph (4) and note following at bottom of page 239, and that all reference to the Class E-4 car be eliminated from Sections C, F, G and K of this rule.

Reason: Class E-4 cars have not been permitted in interchange from owners since January 1, 1937.

The committee recommends that first sentence of Section J of this rule be modified to include tanks of tank cars, effective August 1, 1939, to read as follows:

Section J.—Return of Serviceable Material to Car Owner:

1. When car owner is requested to furnish settlement value of a car under this rule, such owner when furnishing settlement value may instruct the handling line to return cast-steel truck side frames, metal truck and metal body bolsters, metal draft arms, friction draft gears, cast-steel yokes, metal ends and auto loading devices; also *tanks,* special castings and valves of tank cars.

Reason: To permit owner opportunity to recover such tanks, if desired.

Passenger-Car Rule 4

The committee recommends that the effective date of second paragraph of this rule, with reference to equipping all-steel or steel under-frame cars with cardboards or suitable receptacle for the accommodation of defect and joint-evidence cards, now set at January 1, 1940, be extended to January 1, 1941.

Reason: The present situation justifies this extension.

Passenger-Car Rule 8

The committee recommends that a new last sentence be added to Section (h) of this rule, which specifies delivering-line defects, as follows:

Proposed Form: (h) Burst or broken steam pipes and fittings, damaged steam valves, traps and parts of same (inside of car), when due to freezing, on cars equipped with a combined steam-heat cut-out and drain valve, also on cars equipped with hot-water system of heating, except when accompanied by porter furnished by car owner, who fails to bring to the attention of the handling line conditions that would cause any of the parts above mentioned to freeze. *The same responsibility applies to burst or broken water tanks, pipes and fittings (inside of car), when due to freezing.*

Reason: Handling line should properly protect cars from damage by freezing.

Passenger-Car Rule 13

The committee recommends that a new seventh item be added to Section (b) of this rule (no labor or material charge permitted), effective August 1, 1939, as follows:

Proposed Form: *Lubricating and adjusting manually operated truck clasp-brake slack adjusters.*

Reason: It is felt no charge should be permitted for this operation.

The report was signed by W. H. Flynn (chairman), general superintendent motive power and rolling stock, New York Central; J. P. Morris (vice-chairman), mechanical superintendent, Atchison, Topeka & Santa Fe; R. G. Bennett, general superintendent motive power, Pennsylvania; A. E. Smith, vice-president, Union Tank Car Company; J. A. Deppe, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific; L. Richardson, mechanical assistant to vice-president and general manager, Boston & Maine; G. E. McCoy, assistant general superintendent car equipment, Canadian National, and M. F. Covert, general superintendent of equipment, General American Transportation Corporation.

(*The report was adopted.*)

Report on Couplers And Draft Gears

Approved Draft Gears

During the past year a certificate of approval was issued for the Waugh-Gould Type 410 draft gear, bringing the total number of approved gears to eleven which are made by six different manufacturers. One of these manufacturers also has made application for approval of another type of gear. Tests have been completed and the report is being prepared.

The Waugh-Gould Type 410 gear is the first one that has received conditional approval. This signifies that the only information we have about it is based on the laboratory test, and that its performance in service will be watched until it is known that the conditional restrictions can be safely removed and a certificate of approval be granted, or that a certificate should be denied. It has been decided that conditionally approved gears should receive the same protection in interchange that is accorded approved gears, and the Interchange Rules have been so amended.

Because of indications that the manufacturers of draft gears will continue to offer new types for approval, consideration has been given to the problem of limiting the number of approved gears. It has been decided that a gear can remain conditionally approved for a period of not more than two years. At the end of this time the gear must either be withdrawn by the manufacturer or advanced to fully approved status and his former approved gear for the same pocket withdrawn.

Check Tests on Approved Draft Gears

During the year the laboratory work in connection with check tests of two each of seven different types of approved draft gears has been completed. These check tests disclosed some serious failures to maintain the standards of quality that were shown by original approval tests. Inasmuch as there is some evidence of the existence of extenuating circumstances in certain cases, the subcommittee believes it advisable to withhold publication of the results until the manufacturers involved have had full opportunity to examine the test specimens and to offer any explanations they may have to account for the discrepancies found. In any case where a satisfactory explanation cannot be

given and adequate corrective measures have not been taken, the manufacturer will be required to file an application for a complete retest. One thing these check tests have emphasized is the necessity of making them more frequently in the future.

Draft-Gear Attachments and Installations

During the year the subcommittee has worked with the Car Construction Committee to improve the draft-gear attachment situation and has secured adoption of a revised location of the draft-gear support for A. A. R. standard cars to prevent the rear of the coupler yoke from being elevated when the draft gear is closed in pull. Tolerances for standard draft-gear attachments were worked out and adopted to remedy trouble caused by couplers being tight in housings. The Arbitration Committee has reported trouble experienced from mutilation of car center sills because of the indiscriminate substitution of approved draft gears for each other. This is because all approved gears do not use the same carry irons and filler pieces. At one time consideration was given to the possibility of requiring all approved gears to be so constructed that they would use the same carry irons, etc., but after studying the details involved it was decided that the advantages to be gained by such a provision were very definitely outweighed by the disadvantages. A special subcommittee has been appointed to work with the Arbitration Committee to see if some other arrangement can be worked out to care for the situation.

Improvement in Draft Gears on Existing Cars

Interchange rules require approved draft gears on all cars built new after January 1, 1934; on all cars rebuilt after August 1, 1937, unless the underframe construction is such that an approved gear cannot be readily applied, in which case a gear acceptable to the sub-committee may be applied; and all new gears applied to any car after January 1, 1935, must be approved gears unless the pocket will not take an approved gear. These regulations will eventually result in there being only approved draft gears in service. The length of the transition period, in which we now are, will depend upon several factors the trend of which it is difficult to anticipate. Economic considerations prevent the scrapping of large numbers of non-approved gears which still have useful life left, regardless of the desirability of getting rid of such gears. In some cases economic necessity dictates that non-approved draft gears be repaired so as to further increase their useful life. It is hard to obtain agreement on the wisdom of doing this because of the different circumstances which attend individual cases. As an aid toward shortening the transition period, those non-approved gears, which it is most desirable to get rid of, have been classified as obsolete, and the incentive for maintaining them greatly reduced by permitting them to be charged for only on a scrap basis.

The policy has been pursued of giving full consideration to the wishes of both the manufacturer and the user before classifying any gear as obsolete, but the point has been reached where some definite measurement of obsolescence is needed. With this object in view, during the past year sub-committees of the Price Committee, the Arbitration Committee and the Coupler and Draft Gear Committee met in joint conference and recommended that any repaired non-approved draft gear that did not show at least 50 per cent of the required capacity for approved gears, when tested in the Association's laboratory, should be classified as obsolete. This recommendation has been approved by all of the committees involved, and the Draft Gear Sub-Committee is now making arrangements to secure representative samples of the gears in question so that they can be tested at the laboratory.

The Cardwell Type B gears and the Miner Types A-1 and A-IX have been added to the list of obsolete gears effective January 1, 1939. Agreement to this was secured without the necessity of making tests. There evidently is some misunderstanding of what the classification of a gear as obsolete means. When a gear is placed in the obsolete classification it does not mean that the owner must replace all such gears with other gears at the first opportunity.

On the contrary, under present rules, he can repair them and use them on his own cars without penalty. If, however, he applies these repaired gears to foreign cars he can charge only scrap price for them.

Another way in which the committee has endeavored to improve the draft-gear situation is by the proposal of a regulation which was adopted several years ago requiring car owners to inspect for draft-gear slack when cars were due for periodic cleaning of triple valves, and to drop the gears if more than 1½ in. free slack was found to exist. Complaint has been received of train accidents caused by pulling out coupler yokes, with accusation that cases of excessive free slack are being found.

This situation is being investigated further by the Committee and is being checked by the Mechanical Inspection Department of the A. A. R.

Draft Gears for Passenger Service

With the cooperation of a sub-committee of the Committee on Locomotive Construction, the Sub-Committee on Draft Gears has prepared during the year a proposed specification for draft gears for passenger car and locomotive tender service. This proposed specification is submitted herewith. It consists of a brief statement of the essential requirements together with a chart showing two compression and release curves, one for a gear designed for heavy service and one for a gear designed for light service. Submission is made at this time for the purpose of inviting comments and criticism. [Note: The chart is not included with this abstract—Editor.]

General Characteristics and Limitations

The general characteristics and limitations set forth in the proposed specification are as follows:

(a) For the first 1¼ in. at least, the travel of a passenger gear should consist of essentially free spring action to smooth out the pulsating drawbar pull of the locomotive, while the latter part of the travel should be resisted by friction, or equally effective means, with sufficient capacity to absorb occasional heavy impacts.

(b) The initial compression of the gear should be about 3,000 lb., and under a compression of 60,000 lb. the travel should be not less than 1⅛ in. nor more than 1¾ in.

(c) Depending upon conditions for individual applications, the total travel of the gear should be not less than 1¾ in. nor more than 2¾ in., with terminal resistance not to exceed 300,000 lb.

(d) The gear should be so designed that the spring resistance merges gradually into the friction resistance.

[The chairman of the Sub-Committee on Draft Gears is H. W. Faus.]

Swivel Butt Couplers

A member road during 1936 and 1937 built a group of hopper and gondola cars to which were applied A. A. R. Standard E Couplers in Grade B steel, A. A. R. vertical-plane swivel yokes in high-tensile steel and A. A. R. combination striking castings and front draft-gear stops in high-tensile steel. After some months of service it was noticed that these cars were showing a tendency to bulge the center sills in the region of the front draft-gear stop, right-hand side facing the car.

The Mechanical Committee of the Coupler Manufacturers was invited to cooperate with the railroad in making a study of the conditions that might be responsible for this damage. Several months of this study, including car-pushing tests, developed the following information:

(1) It is important that in the manufacture of vertical-plane swivel yokes the front and rear draft-gear bearing pads be made smooth and straight and at right angles with the longitudinal axis of the yoke;

(2) The vertical sides of the swivel yoke in high-tensile steel should be changed to increase the wearing area and reduce the lateral clearance between the front draft-gear stops to provide bearing areas to correspond with the Grade B steel design swivel yoke;

(3) The design of the front draft-gear stops in high-tensile steel should be improved by increasing the thickness of the vertical and horizontal ribs to provide wear surface equivalent to the Grade B steel design.

The changes recommended in the design of the vertical-plane swivel yoke in high-tensile steel to improve guiding between front draft lugs have been approved by the Coupler Committee.

The proposed changes in A. A. R. striking castings with in-

tegral draft lugs in high-tensile steel have been approved by the Coupler Committee and the matter referred to the Car Construction Committee for final action.

Type E Coupler Breakages

It has come to the attention of your Committee that there have been a number of breakages in the side wall of the coupler bodies due to the knuckle tail striking it. Examination of the broken coupler develops that this is due to the failure to open the knuckle when couplers are mated in classification yards. A number of breakages have also been found in the front face of the coupler and a review of these broken couplers shows it is the result of the coupler being struck a heavy blow on the guard arm by the opposing coupler. A thorough analysis of these two failures is being made in order to develop what, if any, changes in design are necessary.

Reclamation of Coupler Knuckles

It has been brought to the attention of the Coupler Committee that the 4⅞-in. nose-to-guard-arm spacing prescribed for reclaimed knuckles as outlined in the committee's report of 1932 is inconsistent with the gaging limits prescribed in Rule 18.

The committee wishes to explain that this closer gaging limit for reclaimed knuckles was prescribed in order that in the process of reclaiming the knuckle, the maximum advantage from a gaging standpoint might be obtained, and any variation from the 4⅞-in. spacing simply means so much loss in service from the nose-to-guard-arm gaging standpoint.

Safe-Lock Couplers

It was mentioned in last year's report that a modified design of coupler intended to prevent vertical slipovers and also provide a support for a coupler pulled from an adjacent car had been suggested to your committee.

This attachment on the standard coupler would increase the weight about 10 lb. and the price a proportionate amount. While there is some question about this type of coupler making coupling within the various ranges of coupler heights, the most serious objection and the one that condemns it from an interchange standpoint is that it cannot be coupled with the standard tight-lock couplers.

The Coupler Manufacturers and your committee have been endeavoring to develop some means by which these protection features might be provided on standard equipment, but so far the best development is represented in a casting that is located under the coupler head and supported by the guard arm on one side and the knuckle pin on the opposite side. This construction requires a longer knuckle pin with a nutted bottom end. The arrangement increases the coupler weight about 26 lb. and in lots of 1,000 would cost approximately $3.25 each including casting and special knuckle pin.

It is the opinion of the committee that the most practical and effective means for combating vertical slipovers is the more general use of 11-in. face knuckles in replacement of 9-in. face knuckles. The 11-in. face knuckles for Type E or D couplers cost only 30 cents more than the 9-in. face knuckle. It is the recommendation of the committee that the further production of 9-in. face knuckles for all types of couplers be discontinued and the patterns scrapped.

Specification for Type E Couplers in High-Tensile Steel

The increasing demand for Type E couplers in high-tensile steel is such that a specification covering this specialized product should be available for guidance of roads desiring high-tensile steel couplers.

Instead of preparing a separate specification covering Type E couplers in high-tensile steel, it was decided that Specification M-204, which covers the Type E coupler in Grade B steel, could be modified to include the couplers in high-tensile steel. The specification has been prepared along this line and has met the approval of the Committee on Specifications for Material, and the revised specification M-204 was appended to this report as Appendix B.

Tight-Lock Couplers

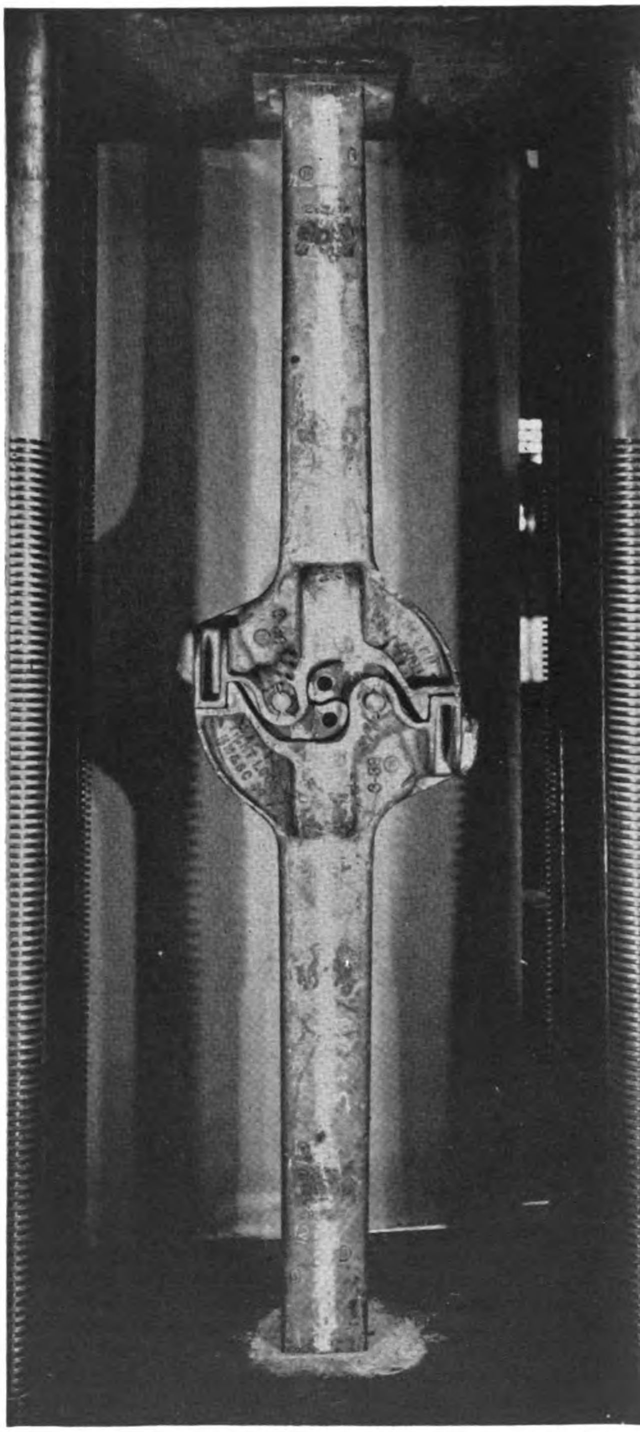
In the 1938 report, mention was made of the attention the Coupler Manufacturers were giving to certain details of refinement in the design and construction of tight-lock couplers. This study has been further advanced to the point where it now includes:

(1) An increase in the amount of surface of the contour to be machined.

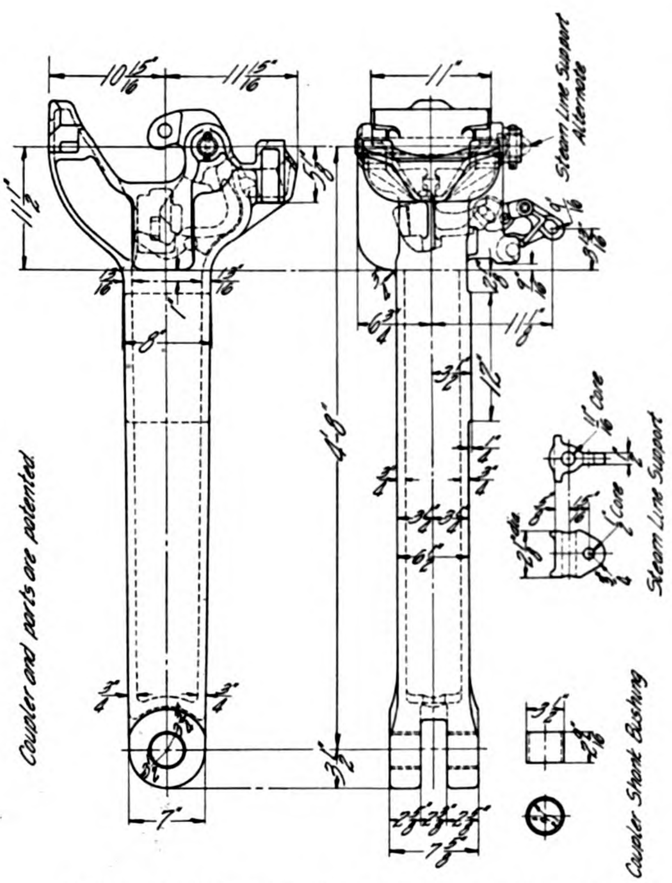
(2) A revision of the location and size of the knuckle-pin hole in both bar and knuckle to provide for boring holes and the holes in the bar and knuckle to be concentric with each other.

(3) An improved anti-creep feature for the lock which definitely prevents the lock creeping in service and provides also for improved coupler operation.

(4) The gathering wing pocket on the knuckle side of coupler head has been revised to its original design as there no longer



A.A.R. tight-lock couplers with shanks under compression load of 1,000,000 lb.



A.A.R. tight-lock coupler for passenger equipment cars

exists the necessity for accommodating the tight-lock coupler to the control-slack coupler. This will provide more clearance for steam lines and improve the interlocking conditions.

These changes have been incorporated in the equipment and couplers manufactured subsequent to January 1, 1939, incorporate these improvements.

The principle of the tight-lock coupler is sufficiently different from the Standard E type coupler that it is desirable to provide instructions concerning the handling and maintenance of the tight-lock coupler.

These instructions are shown in Appendix A of the report and will also be issued as a separate circular.

Attention is called to these instructions in which are shown three types of coupler operating attachments that have been designed as satisfactory for use with the tight-lock coupler to suit the three different general types of car construction.

It is recommended that these three designs of uncoupling rods be submitted to letter ballot for adoption as recommended practice.

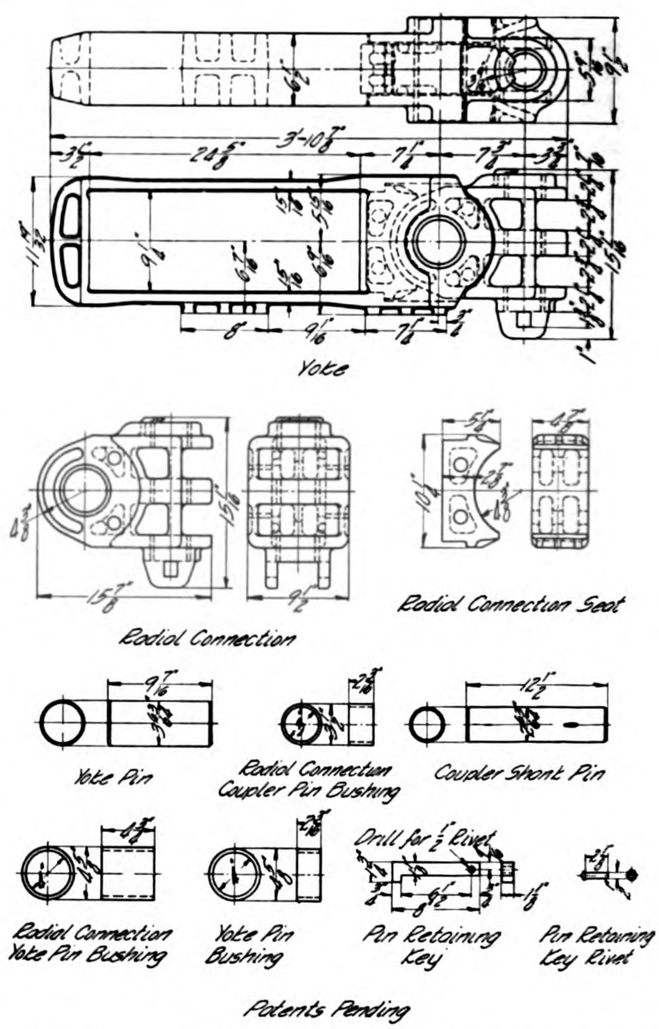
Laboratory Tests of A.A.R. Tight-Lock Coupler, Yoke and Radial Connection

The General Committee of the Mechanical Division, early this year appointed a special committee to develop specifications for design of new passenger equipment cars for interchange service. This special committee at a meeting held in Chicago on January 17, 1939, requested the Mechanical Committee of the Coupler Manufacturers to cooperate with the A.A.R. Committee on Couplers and Draft Gears in the development of a suitable design of shank and attachments for the A.A.R. tight-lock coupler. Further, that laboratory tests be made on the design agreed upon to indicate the strength of the arrangement in tension, compression and in vertical and lateral bending. The special committee suggested that the coupler shank be designed on the basis of 900,000 lb. yield strength as a column under compression. Also, that the anti-telescoping strength of two complete couplers coupled together be not less than 100,000 lb.

During joint meetings of the Mechanical Committee of the Coupler Manufacturers and the A.A.R. Committee on Couplers and Draft Gears held in Cleveland, on January 31 and February 1, 2, and 21, 1939, a design of shank, yoke and radial connection for the A.A.R. tight-lock coupler was agreed upon and a schedule of tests arranged to determine the strength of the unit under various loading conditions which might be encountered in service.

All castings for these tests were manufactured by the National Malleable and Steel Castings Company. All tests were conducted by the Mechanical Committee of the Coupler Manufacturers under the supervision of the A.A.R. Committee on Couplers and Draft Gears. The tests were started on March 15 and completed April 7, 1939.

Tests Numbers 1, 2, 4, 5 and 6 were conducted in a 1,000,000-lb. Olsen testing machine in the laboratory of the National Malleable and Steel Castings Company, Sharon, Pa. Test No. 3 was conducted in a 1,000,000-lb. Riehle testing machine in the laboratory of the American Steel Foundries, Alliance, Ohio. Test No. 7 was conducted in the Pennsylvania's 27,000-lb. drop test machine located at Altoona, Pa.



A.A.R. tight-lock coupler yoke and parts for passenger equipment cars

The results of these tests have not only exceeded by a considerable margin the requirements of the Passenger Car Specification for coupler strength, but have demonstrated that the results are consistent with the results of previous static tension and static compression tests on complete couplers made of high-tensile steel in the Standard "E" Coupler design.

The Committee recommends that this design of tight-lock coupler and attachments be submitted to the association for adoption as standard.

Secondhand Coupler Specifications

Item 3. Marking in the specification for secondhand couplers has been given several interpretations and as a result there has

been some confusion as to just what markings secondhand couplers reclaimed by welding should carry.

This item in the specifications for secondhand couplers has also been somewhat confused with the marking called for in Rule 23 where couplers are welded in the knuckle side wall.

In order to clarify Item 3 of the specifications it is recommended that the following change be made:

Proposed Form: Item 3. Marking—Secondhand couplers having body reclaimed by welding must be stamped with the railroad's initials, followed by the date reclaimed, in the location shown in Figure 1, page 5, of the pamphlet. (This stenciling on secondhand couplers should not be confused with the marking required by Rule 23, Section V(g) on couplers welded in the knuckle side wall.)

There is a correction to be made in the secondhand coupler specifications relating to the number identification of knuckle reclamation gages Process No. 2. Gage No. 25610-2 should be numbered 25610-1, correspondingly Gage 25610-1 should be changed to 25610-2.

The secondhand coupler specifications provide for guard arm distortion gage 25005—designed to measure guard arm distortion on No. 10 contours. As there appears to be a demand for a similar gage applicable to couplers having No. 10-A contours a new gage No. 25005-A has been designed. This gage is so constructed that one side is utilized for gaging the guard arm distortion on the No. 10 contour couplers while the opposite side applies to the No. 10-A contours. This gage is recommended for adoption as recommended practice.

Standard Catalogue Numbers for Couplers and Parts

The Mechanical Committee of the Coupler Manufacturers has been giving attention to the preparation of standard catalogue numbers that may be used by the several manufacturers for identifying parts of the Type D coupler, the Standard E coupler and tight lock coupler, including various attachments. The Committee has been advised that this work is now completed, and this standard system of identifying couplers and parts by the Coupler Manufacturers will become effective July 1, 1939. It is recommended that this information be included in an A. A. R. circular to be issued to the members.

Appendix A—A.A.R. Tight-Lock Coupler Instructions for Handling and Maintenance

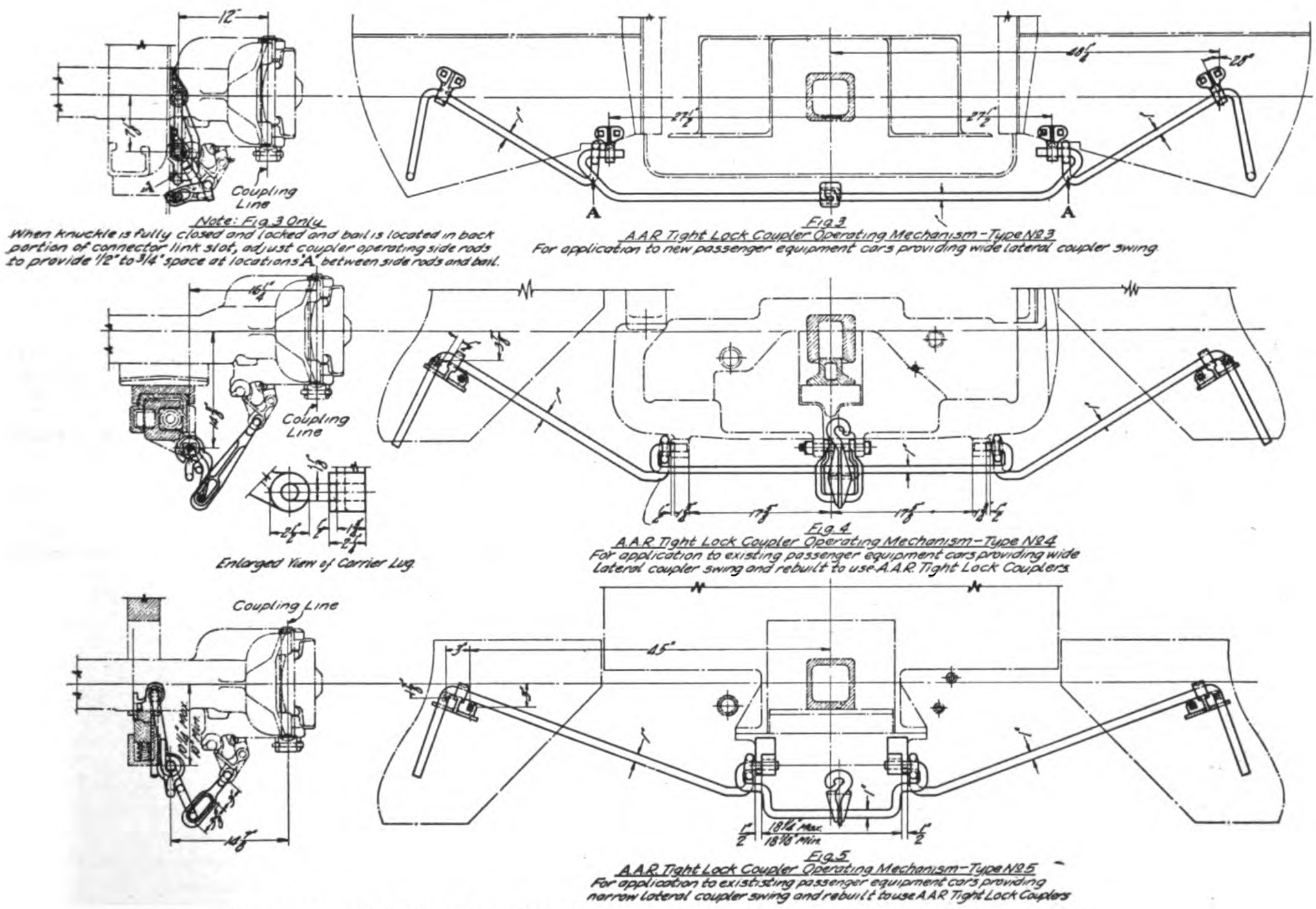
The A.A.R. Tight-Lock Coupler represents a marked departure from the types of couplers in use up to this time. The distinctive design features and the close-fitting conditions of the tight-lock coupler make it necessary to change or modify certain of the practices formerly employed in the use and maintenance of couplers. These instructions have accordingly been prepared as a guide to users of the A.A.R. tight-lock coupler, and their careful observance is considered essential.

Storage: Tight-lock couplers and fittings should be stored in a dry place under cover to prevent corrosion of machined surfaces. Oil, or other coatings, should not be used at any time to protect these surfaces against corrosion.

Inspection and Cleaning: Tight-lock couplers are intentionally designed and manufactured to provide tight fitting conditions. Periodic inspection to assure proper operation of the coupler is therefore important. Accumulations of dirt should be removed by opening the knuckle and blowing out with dry air-blast. If necessary, the coupler should be dismantled for this inspection and cleaning.

Lubrication: Tight-lock couplers in service must be kept free from any lubricants that accumulate dirt or other foreign substances, as these will interfere with proper functioning of the coupler. The inside of the coupler head and the internal fittings must not be painted.

Coupler Maintenance: When tight-lock couplers are reconditioned, especially by application of a new knuckle or lock, the full operation of the coupler should be carefully checked to make certain that it is satisfactory. Also, such couplers should be carefully checked for intercoupling with another tight-lock coupler in order to be assured that this operation is satisfactory,



Three approved designs of coupler-operating mechanism for use with the tight-lock coupler

including proper engagement of the anticreep feature. Replacement of parts in the tight-lock coupler must be made using only standard tight-lock coupler parts, such as knuckles, locks, etc. The space between the underside of the lock and the lock shelf on the knuckle tail must not exceed 5/8 in. Any adjustment of parts necessary to maintain the tight-lock coupler should be made in such manner that the surface, or surfaces, adjusted will remain smooth and true.

Coupler Operating Rods: The design of the coupler operating rod should be an approved type. Three approved designs of coupler operating mechanism, to suit varying car construction conditions, are shown in an accompanying illustration. It is recommended that these approved designs be used whenever practicable. When special design operating rods are necessary they should be designed to avoid any interference with the proper functioning of the coupler.

Coupler Operating Rod Stops and Brackets: The operating rod stops located at the sides of the car should be of such design that they will not be deformed in service, thus changing the position of the rod. Preferably, such stops should be against the car body and not a projecting member. Operating rod brackets should be kept in alignment to prevent binding of the rod. When rubber grommets are used they should be of a type that will not interfere with free movement of the rod.

Steam and Train Line Supports: Any device or arrangement used to support steam or train lines should be located to avoid any interference with any of the coupler operating parts, including operating rods. The location of these supports should be carefully checked under various coupler positions and different types of train lines in order to be assured that interference will not occur during train operation. Train line supports should not be attached to any portion of the coupler.

Coupler Carrier Supports: Tight-lock couplers must be supported in a level position on the coupler carrier and this position should be maintained. When tight-lock couplers are permitted to droop, satisfactory coupling cannot be accomplished for the reason that excessive pressure must be applied to lift the couplers and bring the faces of the bars and knuckles parallel and in full contact to allow the lock to seat.

Intercoupling: When tight-lock couplers are intercoupled, one with another, the operation may be performed satisfactorily with either or both knuckles open. When tight-lock couplers are intercoupled with any other types of couplers, it is recommended that the knuckle of the tight-lock coupler be closed and the knuckle of the engaging coupler be open. When a coupling is made between two tight-lock couplers or between a tight-lock coupler and any other type of coupler, inspection should always be made to make sure that the telltale hole is fully visible. If the telltale hole is not fully visible, the tight-lock coupler is not properly locked.

Tight Lock Coupler Attachments: There are now several designs of tight-lock coupler shank and attachments in service. These arrangements, including draft gears, should be inspected periodically and when necessary adjustments made to eliminate slack. Total free slack should not be permitted to exceed 1/8 inch. One of these arrangements is a machined ball on the end of the coupler shank that assembles in a machined socket in the yoke head. These ball and socket arrangements are protected by an impregnated canvas boot that attaches to the yoke head and wraps the coupler shank. These arrangements should be frequently lubricated and careful inspection should be maintained to be sure that the protecting boot is properly and securely adjusted.

The report as a whole was signed by R. L. Kleine (chairman), assistant chief motive power—car, Pennsylvania System; H. W. Coddington (vice-chairman), chief chemical and test engineer, Norfolk & Western; C. J. Scudder, chief of motive power, Delaware, Lackawanna & Western; L. P. Michael, chief mechanical engineer, Chicago & North Western; J. P. Morris, mechanical superintendent, Atchison, Topeka & Santa Fe, and H. W. Faus, engineer motive power, New York Central System.

In submitting this report the chairman changed the committee recommendations with respect to the design of the tight-lock coupler and attachments in that this design be submitted to the association for adoption as recommended practice, instead of as standard.

(The report was accepted and the recommendations referred to letter ballot.)

Report on Car Construction

During 1938 the full Car Construction Committee, in cooperation with the Freight Car Design Committee of the American Railway Car Institute, undertook an economic study of light-weight box-car designs in line with the program of 1932 which consists of items (a) to (f) inclusive, as covered by Appendix A to Circular DV-768 for that year.

It was agreed that this study would have for its basis the design of a steel-sheathed wood-lined box car having clear inside dimensions of 9 ft. 2 in. wide, 10 ft. high at eaves and 40 ft. 6 in. long as shown by general arrangement Plate 1500, Appendix A to the Annual Report of 1937, Circular DV-920.

It was further proposed to have developed through cooperative efforts of the car builders, the railroads and the specialty manufacturers, designs of the following types of construction: (1) Lightened design in carbon-steel riveted construction; (2) Combination of carbon-steel riveted and welded construction; (3) Alloy steel with combination of welding and riveting; (4) Alloy steel largely of welded construction. This study has been actively followed and tentative designs have been submitted but a considerable amount of work still remains to be done before a general statement of the results may be submitted.

This analysis relates to car body design and construction but, in order that relative weight and cost information may be presented on a comparable basis for the complete car in each case, trucks of the conventional spring-plank design of Grade B steel with nominal weight chilled-iron wheels are to be included at weight per car set of 15,600 lb., as reported in Appendix A to Circular DV-920.

As information, it may be stated at this time that when setting up the carbon-steel riveted-construction body complete as one hundred per cent, tentative results show the following body weight comparison possibilities: Design (1) 94 per cent; (2) 89 per cent; (3) 79 per cent; (4) 76 per cent.

On the question of initial cost the indications are that in reasonable lots, say 1,000 cars or more, the costs per unit complete with conventional trucks would be about the same for each of the designs listed.

It should be recalled, however, that although the smaller car body for the A. A. R. standard design of 1932 having clear inside dimensions 8 ft. 9 1/8 in. wide, 9 ft. 4 in. high at eaves and 40 ft. 6 in. long, weighed about 3,000 lb. less than the then best steel-sheathed designs of equivalent size, the results of subsequent extensometer, deflectometer and also impact tests conducted under collision conditions showed that over-all strength of the new design had been increased some 20 per cent or more over the strength of the two steel-sheathed designs tested in the same manner at that time.

The question of desirable or necessary strength for the light-weight designs has not as yet been gone into in detail, but it is the intention of the committee to investigate this feature further with the A. R. C. I. Committee. This is an important consideration because of its possible effect on anticipated service life and ultimate cost, and further study of the matter might conceivably alter the weight percentages here given and possibly also the relative costs.

New House Type and Hopper Cars Ordered May 5, 1938, to April 30, 1939

Design	No. of cars	Per cent of total
A. A. R. throughout or conforming thereto, including light-weight alloy steel to A. A. R. base dimensions, hoppers with inside dimensions to meet specific conditions	11,875	91.98
A. A. R. except 26 3/4 in. center-plate height	35	.27
Not A. A. R. except inside dimensions	1,000	7.75
Total	12,910	100.00

[Note: Of a total of 18,731 cars, including freight, refrigerator, gondola, flat, stock, and special-type cars not listed in the table, 16,696 cars or 89.14 per cent have the standard center-plate height of 25 3/4 in., and 2,035 cars or 10.86 per cent have a 26 3/4-in. center-plate height.]

Standard Hopper Cars

As a result of further experience gained in the construction

and service of the A. A. R. standard self-clearing hopper cars with particular reference to the cars built with the coped-out center sills, certain detail changes to improve the designs were found necessary or desirable.

These consisted principally in the application of a continuous reinforcing angle on each inside bottom edge of the coped-out portion of the "Z" bar center sills to replace the sectional angles formerly shown.

These changes result in a consequent reduction in the number of rivets for the reinforcing angles and the revisions have the joint approval of the A. R. C. I. and the Car Construction Committee.

[The report was signed by T. P. Irving.]

Center-Sill Section for Use with the 25¾ In. Center-Plate Height

In connection with the production of center-sill section Z-26, the steel manufacturers have had difficulty and to reduce materially the tendency of cracking at the corners they propose the following:

"The upper outer radius between vertical web and horizontal projecting long flange of the Z-bar should have outside corner radius of ⅛ in."

This recommendation has the approval of the American Railway Car Institute Committee on Freight Car Design and also the approval of the Car Construction Committee. It will have no appreciable effect on the properties of the section and will also materially reduce the liability of the edge becoming nicked with the resultant possibility of development of cracks.

A. A. R. drawing 525-C has been revised to cover and has been included in the revision of the Supplement to the Manual.

[This report was signed by T. P. Irving.]

Report of Joint Sub-Committee on Box-Car Floors

The question of damage to box and automobile box car floors, due to heavy concentrated loads imposed by power trucks when handling steel sheets, ingots, bars and similar lading, has been discussed during previous annual meetings of the Mechanical Division and has also been the subject of correspondence between the Operating-Transportation Division and the Committee on Car Construction.

Some time ago a joint Sub-Committee of the Car Construction Committee and the Design Committee of the A. R. C. I. was appointed to study this matter.

After consideration by this committee and the full Committee on Car Construction, it was decided that in view of the information now available and the experience of certain railroads, suitable designs of heavier floors could be developed to cover the situation without conducting special loading tests.

Sketches are being prepared and within the next month proposed floor construction will be sent out under special letter ballot circular.

[The chairmen of the joint subcommittee are T. P. Irving for the Car Construction Committee and W. H. Mussey for the American Railway Car Institute.]

Trucks for High-Speed Freight Service

In the report for 1937 a brief statement was given under heading Light Weight and Less Expensive Trucks for Load-Carrying Cars Used in Regular Passenger Service, Including High-Speed Operation.

This related to a then proposed program of tests for the purpose of obtaining information for use in the development of a lighter and less expensive truck than the conventional equalized swing-motion passenger truck for use under certain types of load-carrying cars operated at the head ends of passenger trains in fast through service and also perhaps applicable to some extent to locomotive tenders. Also, to determine specifically the value first of swing motion, and second, of separate equalization for such service.

Subsequently the instructions to the committee were changed with request for investigation and tests of trucks for high-speed freight service to meet the changing demands of such operations. This matter has been actively progressed under the immediate direction of the mechanical engineer of the division and the tests will be started about June 1, 1939.

Sub-Committee on Side Frames and Bolsters

During the past year no new design of cast-steel side frames of either alloy steel or Grade B carbon steel was submitted to the sub-committee for consideration. The pressed and welded rolled steel side frame has, as stated in the Report of 1938, successfully passed the static tests but as the frame has not yet passed the required dynamic tests, approval has been withheld. Applications pending include side frames for a 40-ton and a 70-ton truck, each spring-plankless and of carbon steel, one 50-ton alloy steel and one 50-ton pressed and welded rolled-steel design, each, for a truck with spring plank.

Reference was made in the 1937 and 1938 reports of this subcommittee to the new designs of pressed and welded rolled-steel side frames and bolsters for 50-ton cars submitted for approval by the United States Steel Corporation. The first design of 50-ton capacity bolster met successfully the requirements of A. A. R. specification for Grade B carbon-steel bolsters and was approved in 1937 for application to cars in interchange, not exceeding 1,000 car sets.

Recently an additional design of 50-ton capacity and two designs of 70-ton capacity bolsters were submitted by the United States Steel Corporation, samples submitted successfully passed the specification requirements of A. A. R. specification for Grade B carbon-steel bolsters and were approved for application to cars in interchange, to the extent of not more than 1,000 car sets of each design. In addition to these bolster designs, one carbon-steel 40-ton spring-plankless design with the Barber stabilized truck was approved.

[H. W. Faus is the chairman of this joint subcommittee.]

Definitions and Designating Letters for Freight and Passenger Cars

During the past year the committee has passed upon a number of requests from car owners for designating letters for new types of passenger and freight cars. After reviewing these requests they have been presented to the membership for approval by letter ballot.

The committee recommended the following new symbols and definitions:

"DE"—Dining Car for use of patrons, fitted with tables and chairs or seats, but without a kitchen.

"DK"—Dormitory Kitchen Car. One portion provided with a kitchen for preparing food for patrons, the other portion equipped as a dormitory for the use of the crew.

"DLC"—Lunch Counter Car. One portion provided with a kitchen for preparing food for patrons, the other portion equipped with a lunch counter.

"DCL"—Lunch Counter Lounge. A car fitted with a lunch counter and kitchen, the other portion equipped with seats or movable chairs. The latter end may be designed as a lounge, observation room or car may be equipped with an observation platform.

[The chairman of this subcommittee is G. S. Goodwin.]

Other Items

During the current year, in accordance with the provisions of the first paragraph of Interchange Rule 3, the committee reviewed and approved seven designs of chlorine container cars, from which thirteen cars were built; one design of lightweight steel-sheathed refrigerator car, from which one was built; one design of well type car, from which six were built; one special design of flat car, from which two were built; one design of tank box car for liquid oxygen, from which one was built; one design of lightweight-steel welded box car, from which fifty were built; one design of pulp-wood rack car, from which fifty were built; one design of lightweight side-dump car, and one design of roofed hopper, from which thirty-five were built. One underframe design for a 50-ton box car was also reviewed.

The subcommittee on revisions to the Manual and Supplement to the Manual made a review of portions of Sections B, E, and L, the entire sections of C and D of the Manual, and the complete Supplement to the Manual. Changes were made, and the revised and new sheets are available and will be issued in the regular manner. The sub-committee suggests that pages which have been eliminated and replaced, be preserved as a matter of record and for reference purposes.

The sub-committee on revision of Interchange Rule 86 for

adjustment of the rail load limit capacity to compensate for various weight wheels now in general use is of the opinion that although the proposed note formulated for addition to Interchange Rule 86 would accomplish the immediate objective sought, it would be necessary before placing the revised rule in effect to adjust upward the capacities of certain axles. It has been considered advisable to await the outcome of fatigue tests, now being made under the direction of the mechanical engineer with full size axles, so as to have available more definite information with respect to the points of highest stresses in such axles for comparison with changes in stresses involved in the adjustment of axle capacities. It is apparent that the fatigue-test results will be of considerable aid to the sub-committee in deciding the extent, if any, to which changes in capacities of present standard axles might ultimately be recommended.

It is recommended that the item of definitions and designating letters be submitted to letter ballot of the members.

The report was signed by P. W. Kiefer (chairman), chief engineer motive power and rolling stock, New York Central System; T. P. Irving (vice-chairman), engineer car construction, Chesapeake & Ohio; W. A. Newman, chief mechanical engineer, Canadian Pacific; F. J. Jumper, general mechanical engineer, Union Pacific System; J. McMullen, superintendent car department, Erie; F. A. Isaacson, engineer car construction, Atchison, Topeka & Santa Fe; G. S. Goodwin, mechanical engineer, Chicago, Rock Island & Pacific; E. B. Dailey, engineer car construction, Southern Pacific Company; J. T. Soderberg, general foreman, Pennsylvania; T. M. Cannon, engineer car construction, Chicago, Milwaukee, St. Paul & Pacific, and H. L. Holland, assistant engineer, Baltimore & Ohio.

Discussion

One member directed the attention of the committee to the fact that on the 40- and 50-ton steel-sheathed box cars the end lining is applied vertically and the stringers horizontally so that when these cars are loaded with grain the lading gets down behind the end lining and lies on the horizontal stringers. It was suggested that the stringers be placed vertically in the car and that the end lining be laid horizontally so that the lading will fall down to the floor, thereby minimizing the possibilities of the car becoming infested with vermin.

(*The report was accepted and referred to letter ballot.*)

Locomotive Construction

Design of Fundamental Parts of Locomotives

Wheel Centers of the Thin-Wall Type

In previous years your Committee has made report on the number of applications made on various Railroads, of wheel centers of thin wall section type. It was decided to discontinue listing all applications as they have become too numerous and therefore, this year we have shown only defects that have developed in the various types of wheel centers to date and feel report of this kind will give more information to members than the actual applications and will be of benefit to the manufacturers in discovering defects in design and making necessary correction for overcoming same.

[The report includes tabular details of each failed wheel center. A summary of the failures of wheel centers of this type is shown in the table.]

Summary of Failures of Thin-Wall Driving-Wheel Centers

Manufacturer	Total no. of wheels in service	Total defective	Percent defective
No. 1	861	35	4.0 Percent
No. 2	7437	30	.4 "
No. 5	502	1	.19 "
No. 3	239	10	4.1 "
No. 4	995	5	.5 "

Design of Frame Pedestal Toes

Sub-Committee has been requested to prepare proposed designs to be added to the manual as recommended practice for pedestal toes. After sending out questionnaire and obtaining data on present designs of pedestal toes on later types of locomotives on large number of railroads Committee on Locomotive Construction recommends adoption of standards shown. The dimensions of toe are based on the width of the frame.

Two different styles are shown and it is the intention of the Committee to have both in the manual so that individual roads can select type desired. It is recommended that this be submitted to letter ballot.

[The width of the pedestal is shown as equal to the width of the frame and the length of the toe below the frame is not to exceed one-half the width of the frame. Taper is one in twelve. One style is tapered on both sides; the other is straight on one side. Fillets and corners are ⅜ in. radius.]

[The chairman of the sub-committee reporting on design fundamentals is L. H. Kueck.]

Exhaust Steam Injectors

During 1938, a total of 58 applications of exhaust-steam injectors were made—19 by the locomotive builders and 39 by the railroads. At this date, the builders have orders for 8 locomotives to be equipped with exhaust-steam injectors.

In addition to those listed, there are on order at the Builders two 4-10-2 locomotives which will carry 235 lb. boiler pressure that will be equipped with the turbo-injector.

[The chairman of the subcommittee is Henry Yoerg.]

Development and Use of Oil-Electric Locomotives

During the year 1938 110 Diesel locomotives were placed in service on 30 railroads or operating companies, making a total of 499 Diesel units in operation on 96 separate railroads or operating companies as of December 31, 1938, with no reported retirements, and as of April 1, 1939, there were 92 Diesel locomotives on order for 21 railroads or operating companies.

The diversified use of the Diesel locomotive is indicated in the horsepower of those units delivered as of December 31, 1938, as follows:

Horsepower	Delivered 1938	Delivered prior to 1938	Increase during 1938 per cent
Less than 300	10	13	77.0
300 to 600	2	116	1.72
600 to 900	51	184	27.6
900	30	43	69.7
950 to 6,000	17	33	51.5

The 600- and 900-hp. Diesels still appear to be the most popular units, although their use is confined principally to switch and transfer service.

The maximum horsepower used in combination up to this time is 6,000. Three units of 6,000 horsepower were placed in service during 1938.

No additional units were assigned in freight service during the year 1938.

As of December 31, 1938, there is a total of 47 Diesel road passenger locomotives in service ranging in horsepower from 600 to 6,000 as compared with 27 units ranging from 600 to 5,400 hp. on December 31, 1937. As in previous years, no attempt has been made to include those Diesel locomotives operating in articulated trains.

At this time a questionnaire is before the membership for additional information, which was not available for inclusion in this report; however, all reports available to the committee have been carefully analyzed and, as approximately 44 per cent of the Diesel locomotives in service as of December 31, 1938, are in the 600 hp. group, some of them with at much as nine years' service life, and since fortunately replies to questionnaires indicated a greater volume of information covering the 600 hp. Diesels than for any other particular horsepower, this information was assembled and is included in the table showing as of December 31, 1937, the service record of 600-hp. Diesel locomotives on selected railroads.

The committee has been unable satisfactorily to assemble information covering maintenance and operating costs of Diesel locomotives of heavier horsepower, operated in main-line passenger service, due to the fact that there is a variation in accounting practice on various railroads and available information cannot be assembled on a uniform basis. However, member roads are now making returns of information requested in the secre-

Typical Service Records of 600-Hp. Diesel-Electric Locomotives operated by Selected Railroads to December 31, 1937

Railroad Index	No. of units	Years in service	Service years	Hours assigned	Hours operated	Percent assignment operated	Lubricating oil: Gallons used	Lubricating oil: Gallons per hr.	Fuel oil: Gallons used	Fuel oil: Gallons per hr.	Repair cost: Labor	Repair cost: Material	Repair cost: Total	Percent repairs for Labor	Repair cost per hour	Hours operated per unit yr.
1	2	3.0	6.0	46,450	37,392	80.50	5,099	.1364	130,153	3.481	....	....	$ 11,740	....	$ .3140	....
	6	4.0	24.0	183,679	153,969	83.83	15,314	.0995	912,986	5.930	....	....	53,233	....	.3457	....
	8	4.0	32.0	233,437	185,086	79.29	18,726	.1012	1,007,945	5.446	....	....	58,299	....	.3150	6,070
2	6	7.95	47.70	421,560	286,350	67.93	*34,981	*.1701	2,150,349	7.510	....	....	212,946	....	.7437	....
	7	2.5	17.5	175,008	129,079	73.76	12,046	.0933	877,179	6.796	....	....	59,998	....	.4648	6,370
3	1	†9.0	9.0	78,888	44,373	56.25	10,692	.2410	350,498	7.899	....	....	69,222	....	1.5600	....
	1	†9.0	9.0	78,888	46,498	58.94	9,537	.2051	370,725	7.973	....	....	59,480	....	1.2792	5,050
4	1	3.5	3.5	26,923	26,923	100.00	2,239	.0832	170,669	6.339	$ 7,988	$ 2,679	10,667	74.89	.3962	....
	1	3.5	3.5	23,210	23,210	100.00	3,167	.1364	184,865	7.965	10,071	2,129	12,200	82.55	.5256	....
	1	2.58	2.58	18,795	18,795	100.00	1,542	.0820	118,598	6.310	5,362	1,320	6,682	80.25	.3555	....
	1	2.16	2.16	16,239	16,239	100.00	1,251	.0770	104,196	6.416	5,343	803	6,146	86.93	.3785	7,255
5	1	5.25	5.25	46,462	34,744	74.78	4,114	.1184	276,924	7.970	15,905	12,634	28,539	55.73	.8214	6,620
6	1	7.33	7.33	56,666	48,483	85.56	6,300	.1299	406,067	8.375	13,761	14,277	28,038	49.08	.5783	6,615
7	1	2.83	2.83	21,481	19,560	91.06	1,311	.0670	123,930	6.336	7,833	2,254	10,087	77.65	.5157	....
	1	3.25	3.25	26,333	25,107	95.34	2,266	.0903	150,566	5.997	7,627	3,174	10,801	70.61	.4302	....
	1	1.33	1.33	10,860	10,139	93.36	1,173	.1157	44,784	4.417	2,664	1,434	4,098	65.00	.4042	....
	1	1.33	1.33	10,853	9,701	89.39	1,117	.1151	43,657	4.500	2,802	1,556	4,358	64.30	.4492	....
	1	1.33	1.33	10,535	9,390	89.13	1,266	.1348	40,896	4.355	2,818	1,169	3,987	70.68	.4246	7,340
8	1	1.46	1.46	10,880	10,425	95.82	743	.0713	62,574	6.002	2,281	714	2,995	76.16	.2873	....
	1	1.33	1.33	11,014	10,451	94.89	921	.0882	69,040	6.606	2,292	806	3,098	73.98	.2964	....
	1	1.46	1.46	10,909	10,440	95.70	673	.0645	64,827	6.209	2,110	583	2,693	78.35	.2580	7,370
9	1	1.33	1.33	11,105	8,599	77.43	1,534	.1784	39,927	4.643	4,045	911	4,956	81.62	.5763	....
	1	1.16	1.16	10,096	7,685	76.12	1,259	.1638	36,076	4.694	3,410	453	3,863	88.27	.5027	....
	1	1.17	1.17	9,928	8,428	84.89	1,256	.1490	37,649	4.467	2,735	389	3,124	87.55	.3707	....
	1	1.16	1.16	9,749	6,750	69.24	1,623	.2404	35,287	5.228	2,945	567	3,512	83.86	.5203	....
	1	1.0	1.0	8,194	4,115	50.22	1,157	.2812	25,738	6.255	2,207	448	2,655	83.13	.6452	....
	1	6.0	6.0	50,284	35,957	71.51	11,429	.3179	257,431	7.159	13,418	12,237	25,655	52.30	.7135	6,050
Grand Total	51	......	195.66	1,618,426	1,227,888	75.87	152,736	.1244	8,093,536	6.591	$117,617	$60,537	$703,072	66.02	.5726	6,275

*No lubrication records for 1929, 1930 and 1931.
†Units in service in 1927—no cost records prior to 1929.

tary's letter of December 12, 1938. It is hoped that this information will be sufficiently complete or that at least selected railroads can prepare this information on a uniform basis to permit of accurate comparison of such locomotives for a future report.

[The chairman of this sub-committee is H. P. Allstrand.]

Standardization of Valves for Locomotives

Your sub-committee reported in 1938 that work was progressing on designs for globe and angle valves suitable for 400 lb. pressure and 750 deg. F. temperature.

There is a very considerable difference of opinion among the various manufacturers as to the proper materials and the design to be used for valves of this character and up to the present time no standards have been developed. Recent investigations, however, have produced information which should be helpful and it is believed that during the coming year the committee will be prepared to make definite recommendations.

[The chairman of the sub-committee is J. B. Ennis.]

Roller Bearings Applied to Locomotives and Tenders

The answers to a questionnaire dealing with practices and performance were summarized in the report. Drawings and instructions of the manufacturers are generally followed for mounting and dismounting bearings. At class repair periods bearings are cleaned and inspected and, if in need of repairs they are returned to the manufacturers by many roads, or replacement parts are ordered and applied in the roads' own shops. Approximately half of the roads reporting have a central shop for this work.

When lubricant is renewed, the bearings are cleaned either by wiping or washing with kerosene, gasoline or light lubricating oil. When one or more axles are removed between shoppings for reconditioning without removing the bearings, the bearings are cleaned, examined and the original tolerances restored. When machining wheels with the bearings mounted, the boxes are covered with burlap, canvas or sheet-metal guards. When equipment is stored, the boxes are oiled or greased and stored undercover. Engines in storage are moved periodically.

Roller-bearing failures result mainly from shelled races and rollers, broken races and rollers, and broken or worn cages. The causes are usually improper cleaning, lack of lubrication, or faulty material and construction.

Reports indicate an increase of 25 per cent to 43 per cent in availability of locomotives with roller bearings. Some roads report little or no difference in road delays due to hot boxes, while others claim a marked reduction. The majority of replies report no increase in mileage between shoppings, while others claim increases of 43 per cent to 100 per cent. Increased mileage between tire turnings run from 20 per cent to 50 per cent.

The reports indicate that the time between bearing renewals is lengthened with roller bearings and that there is a substantial reduction in maintenance—one road claims 50 per cent. Maintenance of driving boxes and hub liners has been materially reduced and reductions in rod-bearing maintenance from slight to 48 per cent for main- and 64 per cent for side-rod bearings are reported. No appreciable reduction in fuel consumption has been found by any of the roads reporting.

[The chairman of the sub-committee is H. Yoerg.]

Shelling of Trailer Wheel Tires

The committee appointed by the chairman of the sub-committee, to visit various shops regarding the machining and handling of trailer tires, developed nothing to account for the shelling. As a matter of fact, one road on which the handling of these tires is very good had more trouble than the others.

Some of the roads have recently adopted the use of heat-treated trailer tires, from which some relief from shelling has been experienced. However, the entire sub-committee feels that additional data should be collected for the next six month period, beginning April 1, 1939, in order to study further the performance of heat-treated tires.

The several roads having trouble due to shelling of trailer tires have been requested to furnish information regarding failures, mileage, and total number of heat-treated trailer tires in service, for a six month period starting April 1, 1939, and ending October 1, 1939.

[E. L. Bachman is chairman of this sub-committee.]

Construction of Locomotive Boiler by the Fusion Welded Process

At the Mechanical Division Convention held in June. 1937, the Committee on Locomotive Construction submitted a report on the above subject. This same subject was referred to briefly at a meeting of the General Committee held on June 29, 1938.

A locomotive boiler constructed by the fusion welded process

was built and applied to Delaware & Hudson locomotive No. 1219 and after stationary tests to comply with Federal requirements were made, the boiler was released for freight service on September 24, 1937, for operation on the Pennsylvania Division of the Delaware & Hudson between Wilkes-Barre, Pennsylvania, and Oneonta, New York, a run of 130 miles. To further comply with Federal requirements, this locomotive was to be taken out of service every three months for the first year so that the boiler could be inspected.

[At the first three quarterly inspections the jacket and lagging were removed and the welding examined under 225 lb. boiler pressure. All seams were found in good condition. At the fourth inspection on September 20, 1938, which was also the annual test, the boiler was similarly examined under 340 lb. hydrostatic pressure. A similar test was made on April 3, 1939. In no case has there been any sign of a simmer or leak from any of the welded seams. At this time the locomotive had made about 105,000 miles.]

The committee will continue to follow this matter during the period of inspection required by the Federal Inspectors who specify that in the first year of service the lagging and jacket is to be removed and the joints examined each three months, in the second year each six months, and yearly thereafter for a period of five years. Each time the hydrostatic test is applied it is to be not less than 50 per cent above the working pressure.

[The chairman of the subcommittee is W. I. Cantley.]

Research Covering Axles, Crank Pins and Bearings

As reported to the General Committee on June 29, 1938, a questionnaire was submitted to the railroads asking for information concerning failures in service of axles and crank pins during the six-year period ending December 31, 1936. The information received from the railroads was tabulated and progress report prepared and mailed to the member roads.

Since that time an additional questionnaire has been submitted to the entire locomotive voting membership calling for extensive information on all crank-pin renewals from November 15, 1937, to February 15, 1938, and on failures only from February 15 to August 15, 1938. A number of replies have been received and as soon as all replies are in it is the purpose to prepare an additional report on this subject for the member roads. As soon as the report is completed it is the intention to send it to the General Committee for approval and upon receipt of this approval, send the report to all member roads. This will probably be ready for distribution early in the fall.

[K. Cartwright is chairman of the subcommittee.]

Obtaining Higher Train Speed Without Reduction in Trailing Load

This subject, as originally referred to the Committee in 1936, presented a problem of moving trains of 750 tons each, excluding weight of locomotive and tender, over level tangent track at speeds of one hundred miles per hour. Consideration was to be given to three forms of motive power, viz.: the reciprocating steam locomotive, the Diesel locomotive and the steam-turbo-electric locomotive. Later the requirements of the problem were changed to call for the movement of 1,000 tons of trailing load at one hundred miles per hour over level tangent track.

In 1937, a special committee was appointed to consider the future development of the reciprocating steam locomotive. The problem of handling 1,000-ton trains at speed of one hundred miles per hour with a reciprocating steam engine was turned over to this committee who are actively engaged with the problem.

The Committee on Locomotive Construction, through its subcommittee on oil-electric locomotives, is keeping in touch with developments in motive power of this type, but it has been only within the last year that there have been built any locomotives of this type sufficiently powerful even to approach the requirements of the problem. The construction and performance of these locomotives will be investigated and reported upon in due time.

The only development along the lines of a steam-turbo-electric locomotive, of sufficient power to meet the conditions of the problem, that has appeared to date consists of the double-unit locomotive recently built by the General Electric Company and delivered to the Union Pacific. Pursuant to a suggestion made by Mr. Burnett, of the Union Pacific, on presentation of the 1937 report of this committee, we requested the privilege of visiting the General Electric works where the locomotive was under construction, for the purpose of inspecting the locomotive and obtaining data regarding it for consideration and use in preparing a report. This privilege was not granted. However, we will continue our efforts to obtain data upon the construction and operation of this locomotive.

[W. I. Cantley is the chairman of the subcommittee.]

Other Items

The subcommittees on Locomotive Guiding and on Stresses in Rods and Motion Work reported progress.

The report as a whole was signed by H. H. Lanning (chairman), mechanical engineer, Atchison, Topeka & Santa Fe; H. P. Allstrand (vice-chairman), principal assistant superintendent motive power and machinery, Chicago & North Western; E. L. Bachman, general superintendent motive power, Pennsylvania; G. McCormick, general superintendent motive power, Southern Pacific Company; W. F. Connal, mechanical engineer, Canadian National; J. E. Ennis, engineering assistant, New York Central; J. B. Blackburn, mechanical engineer, Chesapeake & Ohio; L. H. Kueck, chief mechanical engineer, Missouri Pacific; Henry Yoerg, general superintendent motive power, Great Northern, and K. Cartwright, mechanical engineer, New York, New Haven & Hartford.

(The report was accepted and recommendations submitted to letter ballot.)

Operation of Diesel Locomotives

By H. H. Urbach*

In the last few years, during the period of low earnings of railroads, it has been necessary for railroad officers to take advantage of every opportunity possible to reduce operating expenses.

In analyzing switching operations, it was found that, in a good many places, two and three steam switching locomotives were being used on one 24-hour period. This, then, appeared to be the ideal spot for a Diesel switcher. In some yards it was found practical to work a number of Diesel switchers on 24-hour tricks. We have one such yard, where suitable facilities have been provided for ordinary running repairs, fueling and inspection, and these Diesel locomotives are inspected and such running repair work as necessary is performed during the time crews are changed and during their lunch period. These locomotives are worked 24 hours per day, and are released from service one 8-hour period every week for inspection of pistons, piston rings, cylinder liners, etc., also careful inspection and test of the electrical equipment in order to maintain the engines in good condition.

The operation of Diesel switching locomotives started on the Burlington in May, 1934, when three 450-hp. four-cycle Diesel-electric switchers were purchased. These locomotives were assigned to the passenger yard, freight house and light industrial switching. They were equipped with two four-cycle, six-cylinder, 1,000-r.p.m., 225-hp. Diesel engines, two generators and four traction motors. After being in service two years, these Diesel engines were replaced by the manufacturers with engines having heavier crankshafts, because those originally used in these engines had developed considerable vibration, which resulted in breakage of different parts and which was directly traceable to the light construction of the crankshaft assembly. Since the newer Diesels have been installed, no further trouble has been experienced.

The maintenance cost for the five-year period 1934 to 1938 inclusive, on these three locomotives has been 7.06 cents per mile—2.61 cents of this amount covering general repairs.

Since installing the three switchers in 1934, we now have a total of ten Diesel-electric switchers in strictly yard service,

* Mechanical assistant to executive vice-president, Chicago, Burlington & Quincy.

which are handling 30 eight-hour switch tricks per 24-hour day; and one Diesel-electric locomotive in switching service 8 hours, which in addition handles the work on one branch line. This assignment includes six 600-hp. and two 900-hp. Diesel-electric switchers which differ from the 450-hp. switchers in that they have two-cycle engines.

So far the service obtained from the Diesel switch engines in yard service has been very attractive and satisfactory. The 600-hp. and 900-hp. locomotives have been in service for a period of 20 months and few mechanical failures and delays have occurred. Up to this time these locomotives have not received general repairs. The lubricating oil is changed after 60 days of work. No regular schedule of traction motor inspection has been set up. During 1938 the availability of the 600-hp. and 900-hp. locomotives averaged 98.5 per cent.

No doubt when business and the financial condition of railroads improve, the use of the Diesel-electric switchers will be greatly extended. As the number of Diesel switchers is increased, more knowledge will be obtained concerning maintenance requirements, and more permanent facilities will be provided, all of which will make it possible to establish more definite maintenance schedules.

It is my firm belief that the Diesel-electric switching locomotive has definitely and permanently established itself as the future prime mover for such service, and that the steam switching locomotive will not be perpetuated when new switching power is required.

Diesel Road Locomotives

Early in 1934, we placed the first Diesel-electric road locomotive in operation. This locomotive was powered by a two-cycle lightweight Diesel engine, being an 8-cylinder-in-line with 8-in. by 10-in. cylinders, developing 660 hp. at 750 r.p.m., and weighing approximately 22 lb. per horsepower. Since that time three other locomotives of this type have been built for us and installed in passenger road service. These four Diesel locomotives are handling three and four-car trains, they are averaging 550 miles a day, and up to May 1, 1939, have accumulated 3,498,096 miles.

We also have in service two 1,800-hp. and two 3,000-hp. locomotives with the same type of Diesel engine. The same type traction motors, pistons, connecting rods, injectors, cylinder liners and cylinder heads are used in all sizes of locomotives from the 600-hp. to the 3,000-hp.

The 3,000-hp. locomotives are made up of one 1,200-hp. and one 1,800-hp. unit. A spare power truck was purchased which will fit either the 1,800-hp. or the 1,200-hp., so that in case of a traction motor failure a quick change can be made. This truck provides protection for six engine units with headquarters at Chicago, and which are assigned between Chicago and the Twin Cities, Minn., and between Chicago and Denver, Col.

The 1,800-hp. locomotives are operating on runs of 882 miles a day, and the 3,000-hp. on runs of 1,034 miles a day. The two 1,800-hp. engines have been in operation since December 18, 1936, and up to May 1, 1939, have accumulated 1,413,573 miles. The two 3,000-hp. locomotives have been in operation since November 8, 1936, and up to May 1, 1939, have accumulated 1,754,585 miles.

One of the 1,800-hp. locomotives has its layover at Minneapolis and is maintained at that point on a nine-hour layover, which is the total time between the arrival of train at night and departure the next morning. One 1,800-hp. locomotive is entirely maintained at Chicago on a nine-hour-forty-five minute layover. The two 3,000-hp. locomotives are maintained at both Chicago and Denver; the layover is approximately eight hours. The maintenance work on these two locomotives is divided between the Chicago and Denver terminals, and special facilities have been provided for the character of the work performed at each of these terminals. The on-time performance of these four locomotives on the runs as stated above has been 96 per cent. The availability of all the Diesel road locomotives is 95 per cent.

Just recently a 1,000-hp., two-cycle locomotive of the improved type has been installed. As it has been in service only a short time no comments can be made as to the maintenance requirements. Only certain parts above the crank-shaft of this locomotive are interchangeable with the other locomotives in service.

The average total weight of train per horsepower for the 600-hp. locomotives with three-car trains is 393 lb., with four-car trains 480 lb. The 1,000-hp. locomotive handles 539 lb. per horsepower when pulling its regular train. The 1,800-hp. locomotives handle 422 lb. per horsepower with seven trailing cars. The 3,000-hp. locomotives handle 445 lb. per horsepower with ten trailing cars, and 521 lb. per horsepower with twelve trailing cars.

The failures which have occurred and are responsible for train delays are so varied in character that it is almost impossible to definitely point your finger at any one particular thing; however, the failures that have occurred were due to trouble with traction motor bearings, connecting rod bearings, pistons, cylinder liners, cylinder heads and fuel injectors. As each 1,800-hp. locomotive is equipped with two 900-hp. Diesel engines, where a failure occurs to a traction motor, connecting rod bearing, piston or cracked cylinder head, comparatively little time is lost with the other 900-hp. engine handling the train, as compared to stopping the train and getting a steam locomotive to handle. This same situation applies to the 3,000-hp., as these units are equipped with two 900-hp. and one 1,200-hp. Diesel engine, and where a defective condition develops that makes it necessary to cut out one of the 900-hp. units, comparatively little time is lost with the other two units in operation. If for some reason the 1,200-hp. engine has to be cut out, it is then necessary to use a steam locomotive to handle the train.

As I see it, the successful operation and satisfactory performance of Diesel locomotives in road service resolves itself into a question of a few parts, such as traction motors, power truck wheels, crankshaft, pistons, cylinder liners, cylinder heads and injectors. I will discuss these separately.

Traction Motors

Several road failures have occurred due to hot armature shaft bearings and broken armature shafts. After each failure a thorough investigation was made but due to the damage that occurred, all evidence as to the cause of the failure had been entirely destroyed. In the case of burned up armature shaft bearings, our investigations convinced us that these bearings were failing due to (1) overlubrication; (2) roller bearings damaged in handling the traction motor; (3) bearings damaged because of too much lateral motion accumulating in the hanger bearings; or (4) armature not properly balanced.

In making actual tests we found that quite high temperatures could be set up in the armature bearings by forcing too much lubrication into the housings. As a result of our investigations (1) instructions covering lubrication were changed from 15,000 miles to 30,000 miles; (2) strict instructions were issued with reference to the careful handling of the traction motors in shipping them from the shops and during the time of application; (3) the lateral motion in the support bearings was taken up and maintained at a closer tolerance, and (4) in order to know that the armatures were properly balanced, an accurate dynetric balancing machine has been installed in our shops where every armature is perfectly balanced at the regular inspection periods.

In addition, it was decided to use the cylindrical treads on the power-truck wheels. Tests indicated that cylindrical treads steady the riding of the locomotive and have a definite tendency to reduce the lateral thrusts of the traction motors at high speeds. It is our opinion, with the frail construction of the armature roller bearings (due to the limited space available), and with the very heavy end thrust of the traction motor on the hanger bearings (which on a two-degree curve at 100 m.p.h. amounts to 1,875 lb. per bearing), that the armature breaks out the end of the roller enclosure and causes the bearing to fail and heat. We have also considered the wear on traction motor pinions and on axle drive gears, and as a result have set up specific wear limits which we believe will also have a tendency to assist in eliminating armature shaft bearing failures.

Several failures have occurred account broken armature shafts. We have arranged to use the magnaflux test on the exposed ends of armature shafts each time a traction motor is sent to the shop for mileage inspection. Since putting these practices into effect we have been practically free from armature axle failures and armature shaft bearing failures.

Through the careful inspections that have been maintained since these Diesel locomotives have been in service, we have developed that the traction motors on our 600-hp. Diesel locomotives will run 200,000 miles between inspection and on our

larger Diesel locomotives 150,000 miles. We have 34 traction motors in daily service and have an assignment of 9 for protection and maintenance. The inspection and repair work of these traction motors has been confined to our Aurora shop where the dynetric balancing machines and other facilities have been provided to make all necessary repairs economically and expeditiously.

An undesirable situation exists when an armature shaft bearing fails, as no means is provided to cut the traction motor out of service. As a result the armature drops down on the pole pieces and practically destroys the armature, pole pieces and field coils, and in some cases has caused the wheels to lock and slide. In several instances where this has occurred enroute it has been necessary to set out the locomotive and handle the train with a steam locomotive. In some cases, when an acetylene torch was immediately available, the armature shaft has been cut off. Some means must be provided so that in case of an armature shaft bearing failure, that particular traction motor can be disengaged from the wheel and the locomotive continued to handle the train with the other traction motors.

Power Truck Wheels and Axles

When the Diesel locomotives were first put into road service, they were equipped with a 1½-in. rim wheel according to A. A. R. specification M-107-34. The analysis was: Carbon, .67 to .82; manganese, .60 to .85; phosphorous not over, .05; sulphur not over, .05; silicon not less than, .15.

The service obtained from these wheels was fairly successful and we averaged approximately 104,000 miles during the life of the wheel. In the meantime considerable research work was done by the steel companies and there was developed what was known as a low-carbon molybdenum wheel, the analysis of which is as follows: Carbon, .48 to .63; manganese, .60 to .75; phosphorous not over, .04; sulphur not over, .05; silicon, .15 to .25; molybdenum, .40 to .50.

When the 1,800-hp. and the 3,000-hp. Diesel locomotives were built they were equipped with this specification of wheel, with a 2-in. rim. We soon found that due to the severe braking, the wheels were thermal checking badly and shelling out, and after running for a period of a year, we found that we were getting only an average of 84,000 miles during the life of the wheel.

We then went to the use of what was known as a high-carbon molybdenum wheel of the following analysis: Carbon, .58 to .73; manganese, .60 to .75; phosphorous not over, .04; sulphur not over, .05; silicon, .15 to .25; molybdenum, .20 to .30.

These wheels gave about the same service as the low-carbon, and as a result of the poor performance of the so-called low-carbon and high-carbon-molybdenum wheels, we changed back to our former specification of what we termed a "plain carbon" wheel, but with a 2-in. rim thickness. As a result we practically eliminated all thermal checking and shelling, and increased the life of these wheels from 84,000 miles to 142,000 miles.

These wheels were all equipped with the standard A. A. R. axle, with the following analysis: Carbon, .40 to .55; manganese, .60 to .90; phosphorous not over, .045; sulphur not over, .05; silicon not less than, .15; nickel not over, .25; chromium not over, .15.

These have been very satisfactory and we have a number of axles in service that have made over 600,000 miles. The mounting and dismounting of power truck wheels is all handled at our Aurora, Ill., Shop, where the axles are given the magnaflux test each times the wheels are removed for renewal.

Crankshafts and Bearings

After several main-bearing stud failures, the crankshaft main bearing caps and the feet members of the crankcase bearings were serrated so there would be no movement of the main bearing caps.

On the connecting rods the upper bantam roller bearings run approximately 200,000 miles before they have to be renewed; on the lower end the first type bearings were primarily 98 per cent lead and we obtained approximately 245,000 miles between renewals. With a later bronze type bearing with a high lead content we expect to obtain over 500,000 miles between renewals. The main crankshaft bearings are renewed every 400,000 miles, at which time they show small shellout spots.

So far it has not been necessary to completely regrind any of the crankshafts. During the combined mileage up to May 1, 1939, of 3,168,158 miles on the four large engines, we have renewed two crankshafts, one because a crank pin bearing had been turned undersize after failure of the connecting rod bearing, the other because of an incipient crack developing after the crank pin had been ground and the sharp edges of the oil hole had not been rounded and polished.

On the small trains up to May 1, 1939, the four 600-hp. locomotives have averaged 874,524 miles, during which time the wear on crankshaft bearings was less than .009 in. It has not been necessary to regrind any of these shafts. Past experience indicates that we can expect at least 1,500,000 miles per crankshaft before it becomes necessary to recondition them.

Pistons, Piston Rings and Cylinder Liners

At the beginning we had quite a number of piston failures, mainly due to improper design and an alloy which had not been perfected for such exacting service as on a two-cycle Diesel engine. After considerable research and development pistons were made of a different alloy, also the interior and ring land construction was changed to obtain more even expansion and better heat dissipation. Later on the forged type pistons were tried out with very satisfactory results. In order to make still further progress in the art of developing pistons, we are experimenting with the latest type cast piston, which it is felt will be superior to any heretofore used.

With the exception of piston rings sticking in the second ring groove from the top of piston, ring troubles have been nil.

During the accumulated mileage up to May 1, 1939, of 6,666,-253, we have reground only 21 cylinder liners 1/32 in. oversize. At the beginning quite a number of liners were replaced due to defects in the castings. The liners that did not have any defects are still in service and very few of them have worn beyond .008 in. in diameter. When the wear exceeds .025 in. at the upper end of liners, they are reground 1/32 in. oversize and reused with oversized pistons.

Cylinder Heads

A little over a year ago we experienced considerable trouble with cylinder heads cracking across the valve bridge. After extensive research it developed that the failures were due to an airbound condition in the water cooling system. In one instance we found a leaky gasket on the air compressor head. This air was trapped in the cylinder head, creating a steambound condition, with the resultant overheating and cracking of the valve bridge. That airbound condition was eliminated by the application of ½ in. copper tubing which vents any air in the water cooling system to the atmosphere. Since that has been done we have had very little trouble with cracked cylinder heads. So far no cylinder heads have been scrapped for any other reason.

Fuel Injection System

On the original Diesel engine considerable trouble was experienced with an airbound condition in the fuel injection system, due to utilizing one manifold as a fuel feed and return. That condition was corrected by the installation of a second manifold to serve as a fuel return only, thereby eliminating any airbound condition to the adjacent injector or injectors should one become defective.

Before making the improvements enumerated above, quite frequently fuel injector failures occurred en route; however, since then we have had very little difficulty with defective injectors. When an injector does become defective it is cut out by the crew in charge and the engine continues to handle the train with little or no loss of time.

Maintenance Facilities

The inauguration of Diesel locomotives in road service necessarily meant the establishment of proper facilities for handling the work, and special fueling facilities en route so that fuel oil could be taken with very little standing time. Due to the high-speed schedules on which these Diesel locomotives are operating, it means that most of the stops are only of one or two-minute duration. Fuel must be taken once between Chicago and Denver, Colo., and this made it necessary to provide one fueling station, which was located at Lincoln, Neb., where it is possible to supply 1,700 gal. of fuel oil in five minutes. As crews are changed at this point very little delay occurs taking fuel over that consumed changing the crews.

At Chicago and Minneapolis, Minn., inspection pit facilities with drop tables and cranes were provided so that power trucks can be changed in a very short space of time. The spare power truck and all protection traction motors are kept on hand at Chicago, where all of the work of changing power trucks and traction motors is performed, except for the one train which is maintained at Minneapolis and in this case when it is necessary to make a change of motors or power truck, the motors or power truck are shipped to Minneapolis.

At Chicago, Minneapolis and Denver special fueling and lubricating oil facilities were provided so that engines can be fueled and also that crankcase oil changes can be quickly made. At Denver no special mechanical facilities were provided and no protection power truck or traction motors are maintained, because we have found it unnecessary to maintain these items at that terminal.

General Repairs

The general repairs on these Diesel locomotives are handled at our locomotive shop, West Burlington, Iowa, where no special facilities have been provided. Because of the general character of the Diesel engine most parts that are renewed are purchased to a standard size and usually, with the exception of lifting the Diesel engine in and out of the cab, the parts can be lifted by hand.

Protection Power

You will note from my discussion in this paper that no mention is made of any Diesel engines used for protection service. With the two 1,800-hp. and the two 3,000-hp. Diesel locomotives operating a total of approximately 3,850 miles a day, some protection necessarily must be provided. When this service was started it was decided that we would not purchase additional Diesel locomotives for this protection but would remodel and modernize four of our Hudson type steam locomotives and build one additional new Hudson type locomotive. These locomotives were modernized to the extent of equipping them with roller bearings on all wheels and valve motion, applying lightweight reciprocating parts and lightweight roller bearing rods.

In addition to furnishing protection for Diesel operation, these steam locomotives are assigned to regular trains operating over the same territory as the Diesel locomotives; for instance, two streamline Hudson-type locomotives operate daily between Chicago and Minneapolis, one locomotive has an entire day layover at St. Paul every day and one has an entire day layover at Chicago—these locomotives furnish the necessary protection for the operation of the Diesel trains between Chicago and Minneapolis. Three of the modern type locomotives are operated on our train Aristocrat between Chicago and McCook, Neb., a total of 779 miles—this provides the necessary protection on the west end of the railroad every day and also makes it possible to protect the Diesel trains en route between Chicago and McCook, Nebraska. One of these locomotives lays over every day at McCook, one is en route and one lays over at Chicago every night. Since these five steam locomotives have all been placed in active service, in addition to protecting the Zephyr trains, they have averaged 12,576 miles per month. One locomotive during this period has averaged 14,513 miles per month.

You will note from the foregoing that in addition to giving us all the protection we need on the Diesel-operated trains, these steam locomotives give a very good account of themselves in handling conventional trains.

In conclusion, I have tried to point out in this paper the great serviceability of the Diesel locomotive in road service and the time required for maintenance, which leads me to believe that the Diesel road locomotive has made considerable inroads on the steam locomotive, and it is my opinion that as time goes along more and more Diesel locomotives will be used for road service, supplanting steam.

Some additional development work is still to be done on the Diesel locomotive to make it entirely satisfactory; however, it appears to me that the same statement can be made about the steam locomotive, in fact, I do not believe that as much progress has been made in the last five years in the development of the steam locomotive as on the Diesel.

Discussion

Written discussions of Mr. Urbach's paper were presented by H. P. Allstrand, principal assistant superintendent motive power and machinery, C. & N. W.; J. P. Morris, general assistant, mechanical department, A. T. & S. F., and G. F. Wiles, Supervisor of Diesel-electric locomotive operation, B. & O.

Mr. Allstrand said it seemed to be quite generally the opinion that the minimum assignment on which Diesel-electric switchers can be justified is 16 hours a day and, for passenger service, 800 to 1,000 miles per day. Even where assignments of steam passenger locomotives are in excess of 500 miles a day, which is not unusual, the service is accomplished with a cost for layovers and relief power in excess of that required for protection of Diesel-electric locomotive assignments. The possibility of carrying on repairs while the unit is en route, he said, permits a greater continuity of service than has ever been possible with reciprocating steam locomotives.

"There are many examples of the dependability of this type of equipment," he said. "We are familiar with assignments which are operating approximately 275,000 miles per year on sustained runs of approximately 2,300 miles on which during an entire year of operation there were no late arrivals chargeable to mechanical failures. True, in many cases repairs enroute were required. It is also true that the locomotives have been continued on the trip with part of the Diesel or electrical equipment cut out, or at least not effective for handling the train, but such cases did not result in excessive delays and at least did not require the power unit being cut off the train."

Mr. Allstrand gave the experience of the C. & N. W. with three 300-hp. switching units which have been in service since 1926 and 1927. They were assigned to 24-hr. service, with an eight-hour period per week for inspection and maintenance. For periods varying from 10 yrs. 9 mos. to 11 yrs. 8 mos. these three locomotives have averaged 84.7 per cent availability, or 5,250 hrs. per year. The consumption of lubricating oil varies from 0.104 to 0.12 gal. per hr., and the fuel oil from 3.817 to 3.939 gal. per hr.

"The record of repair costs for this long period of service is interesting," said Mr. Allstrand. "The lowest average cost per hour for the entire service period for any unit was 64.6 cents and the maximum was $1.07, or for the three units an average cost of 83.6 cents per hour or 13.93 cents per mile. This cost includes running repairs, inspection, general repairs, and parts replacements, and also includes the replacement of crankshafts on two of the units. These crankshafts failed due to faulty design at the connection between the engine and the generator during the first five years of operation. Also of interest is the fact that the average cost of repairs for the last five years service is not greater than the average cost of repairs for the first five years of service.

"During 1937, we placed in service eight 0-6-0 (steam) switchers with a tractive force of 54,000 lb. These locomotives were very desirable for the service and as a result have been in constant demand. They have been operated an average of 4,630 hours per year as compared with 5,250 hours for the Diesel locomotives. The cost of repairs to the steam switchers averaged 88.86 cents per hour or 14.81 cents per mile as compared with 83.6 cents per hr. for the Diesel switchers or 13.93 cents per mile. Of course the steam switchers were in much heavier service than the 300-hp. Diesel switchers."

At the outset of their Diesel-electric operation, Mr. Allstand said the C. & N. W. had followed the practice of removing the locomotives from service every three months for piston, valve and bearing inspection. This was extended, first, to six months and later to one year. For the past two years, he said, none of them has been in the shop for any repairs other than week-end inspections and light repairs.

In 1930 a 600-hp. Diesel-electric switcher was placed in service. Mr. Allstrand said that, for the first eight years, this locomotive has had an availability of 86 per cent; its lubricating-oil consumption has been 0.13 gal. per hr. and its fuel consumption, 8.37 gal. per hr. The average cost of repairs has been 58 cents an hour. This, he said, is accounted for in part by improved design and in part by the greater capacity, which has reduced the abuse from overloads.

"An interesting point in the maintenance of this 600-hr. unit is the fact that it was operated for eight years or approximately 55,000 hours before being shopped for general repairs," said Mr. Allstrand. "The cylinder liners after eight years' service were worn to approximately .0075 in. taper. They were bored and rebushed and the original pistons were re-installed. The main bear-

ings were removed to permit inspection of the crankshaft and were replaced without any repairs. It was deemed advisable to renew the connecting-rod bearings. During this period there were no major repairs to main generator and no major repairs to traction motors other than periodic repainting and baking the insulation, which service was performed at four-year intervals.

"Unquestionably, the original 300-hp. units were damaged and the increased repair cost in part resulted from overloading and attempting to do work for which the machines were not designed."

Mr. Allstrand called attention to an unusual practice of wheel maintenance which the C. & N. W. has adopted on its first four Diesel-electric switchers. When the original traction wheels needed replacement, they were replaced with wheel centers and removable tires. When tires reach the scrapping limit, they are renewed without disturbing the wheel fit on the axle. This is believed to have effected considerable economy.

Mr. Morris, speaking of Diesel-electric switching locomotives, said that placing them in service involved no major problem, so far as the enginemen were concerned, but that the maintenance routine was entirely different from that for steam locomotives and maintenance forces required special training.

Referring to the Santa Fe operation of Diesel switching locomotives 23 hrs. a day continuously between 30-day inspections, Mr. Morris said: "Once each 24 hrs. during the crew's lunch period locomotives are inspected and at the time of monthly inspection careful inspection is made and necessary tests, cleaning, and repairs to equipment are made, also the brakes, trucks, and running gears are given close inspection, and the Diesel engine is inspected for oil leaks, fuel leaks, pounds, valves, piston blows, or any dirty condition inside or outside of the engine.

"With reference to holding locomotives one eight-hour period every week for inspection of pistons, piston rings, cylinder liners, and also careful inspection and test of electrical equipment: While there is no mention made of how the inspection is made, I assume that the condition of the pistons, rings, and liners is determined by an inspection through the wind box. This method does not permit a complete inspection of the pistons, rings, or liners, as only one-third of the parts are visible to inspection by this method and we have had failures of pistons immediately after an inspection of this kind.

"On all two-stroke cycle engines pistons are removed and liners and connecting-rod bearings are inspected once each year, but in some cases we find it necessary to renew these parts between annual inspections. On the later four-stroke cycle engines purchased in July, 1937, no monthly inspection is made of the pistons and bearings, and we have not found it necessary to renew any of the pistons or bearings since the date they were placed in service. At the end of two years' service the pistons will be removed for inspection and at that time the bearings will be given attention, if necessary.

"We are hopeful that, with the new two-stroke cycle 1,000-hp. Diesel locomotives that we have recently ordered, which have the improved type pistons and additional piston cooling, will show up favorably with the four-stroke cycle engine in piston performance."

Mr. Morris said that eleven locomotives, nine of which are in the Chicago territory, work 31 eight-hour tricks daily and average 90.6 per cent availability. He called attention to the fact that they have one experimental locomotive which has been held out of service frequently to make changes in the course of the development of the locomotive. This, he said, would account for the unfavorable comparison with the locomotives on the Burlington.

In light switching service he said that crank-case oil changes are made once in six months. On the 900-hp. locomotives in heavy switching service the oil is changed every 90 days. There is no regular schedule of traction-motor inspection, but one will be developed when sufficient experience has accumulated. Mr. Morris sees no reason why the Diesel-electric switching locomotives should require general repairs until such time as crankshaft renewal is necessary.

In the table are the average operating costs per service hour. The operation of these locomotives, he said, has been very satisfactory, and, where they can be worked continuously for 24 hrs., they will show a more economical performance than steam switching locomotives.

Mr. Morris then took up the experience of the Santa Fe with Diesel-electric locomotives in passenger-train service, from the installation of the experimental 3,600-hp. locomotive placed in service in August, 1935. This locomotive was later remodeled into two 1,800-hp. locomotives and had accumulated 1,026,877 miles to May 1, 1939. The remodeled units are now handling two seven-car lightweight trains between Chicago and Wichita, Kan., a distance of 678 miles. The principal changes made as the result of experience with the original locomotive have been a better system of cleaning combustion air, better cooling of the Diesel engine, providing filters of sufficient capacity to the engines, crankshafts redesigned to prevent breakages, piston redesigned, a revised fuel system, traction motors redesigned to provide better fan construction, and redesign of the main generator armature to overcome too light construction. The steam generators were redesigned and the steam capacity increased.

Average Cost per Service Hour of 11 Diesel-Electric Switching Locomotives* on the A. T. & S. F.—Year 1938

Repairs	$ .24
Depreciation	.53
Wages of enginemen	1.58
Fuel	.26
Lubricants	.07
Other supplies	.01
Enginehouse expenses	.05
	$2.74

* Three 600-hp. four-cycle, four 600-hp. two-cycle, one 660-hp. four-cycle, and three 900-hp. two-cycle.

The assignment of seven 1,800-hp. and three 3,600-hp. Diesel-electric passenger locomotives is shown in the table. For the period April, 1938, to April, 1939, Mr. Morris said that these locomotives have made 2,061,674 miles with an average availability of 94.8 per cent.

Assignment of 10 Diesel-Electric Passenger Locomotives on the A. T. & S. F.

No. of trains	Name of train	Loco. hp.	No. cars in train	Load per loco. hp.	Mileage of run	Scheduled time, Hrs.	Min.
2	El Capitan	1,800	5	458	2,227	39	45
1	Kansas Cityan	1,800	7	558	678	11	45
1	Chicagoan	1,800	7	558	678	11	45
1	San Diegan	1,800	7	561	520*	10	0
2	Super Chief	3,600	9	431	2,227	39	45
1	Chief and	3,600	11	517	451	9	29
1	Ranger	3,600	13	690	451	10	20
2	Golden Gate	1,800	7	566	626†	11	10

* Two round trips
† Round trip

He called attention to the fact that such parts as pistons, connecting rods, cylinder liners, and cylinder heads are not interchangeable between the engines in the 600-hp. to 3,600-hp. locomotives of the two-cycle type, and that none of the parts in the new 1,000-hp. two-cycle Diesel engines for the 4,000-hp. locomotive now on order are interchangeable with the engines now in service. He recommended that manufacturers consider standardization of parts in order to keep down store stocks.

In comparing performance of Diesel-electric locomotives, Mr. Morris thought that much depends upon the character of the service the locomotive renders. He thought the service on the Santa Fe between Chicago and La Junta, Colo., would be comparable with that on the Burlington between Chicago and Denver, Colo. From La Junta, Colo., to Los Angeles, Calif., he pointed out that the Santa Fe had 567 miles of grade, westbound, ranging from 0.6 per cent to 3½ per cent; where the Diesel engines are operated at maximum capacity. Westbound, only one helper is used for 16 miles of 2-per cent to 3½-per cent grade over Raton Pass, and, eastbound, two helpers are used, one for 19 miles of 2.2-per cent grade over Cajon Pass and one for 8 miles of 3½-per cent grade over Raton Pass.

"For about two months," said Mr. Morris, "transcontinental trains were operated without using helper service over 3½-per cent grades. This practice was discontinued as the solder on armature-band wires was thrown off and bandwires loosened up.

The sealing compound around field-pole holding bolts melted and ran out. This sealing compound melts at about 150-deg. C (302 deg. F.). Of course, operating under this temperature condition the insulation was damaged.

"Helpers are now used over Raton Pass, westbound, and over Cajon Pass and Raton Pass, eastbound, but some indications of excessive temperatures are still present, such as insulation on the armature becoming very dry and hard, and solder joints at commutator riser loosening up, which will, in time, result in insulation failures. This condition leads to the opinion that the present motor does not have heat dissipating capacity for present service, and it was thought necessary to provide additional ventilation. This is being done by means of ventilators in the roof of the locomotive, which provide clean air under pressure for the traction-motor blowers."

Traction motors are removed every 200,000 miles and sent to the manufacturer for inspection and repairs, but Mr. Morris said that as more locomotives go into service, consideration will be given to making these repairs in one of their own shops. There has been no trouble with over-greasing of motor bearings, he said. Four ounces of grease is applied to the commutator-end bearing every 25,000 miles, and eight ounces to the pinion-end bearing every 5,000 miles.

With respect to motor-bearing failures which let the armature down on the pole pieces and lock the wheels, Mr. Morris said: "We had similar experience with a 3,600-hp. Diesel locomotive. This occurred on rear wheels of the rear unit, causing the truck to derail on account of the wheels locking and sliding, and could have resulted in a more serious accident if the same condition had occurred on front wheels of the leading truck. In this particular case, any means that would have been provided to disengage the motor in case of an armature-shaft-bearing failure would not have prevented the accident.

"We have built two experimental trucks without the motor on the leading wheels. The motors are placed on the second and third pairs of wheels in each truck. These trucks were placed under the two 1,800-hp. remodeled locomotives and have rendered very satisfactory service."

Crankshaft-bearing failures have caused considerable concern, he said. "We have removed bearings which showed metal fatigue and in some cases the bearings have sloughed away, resulting in many cases of steel-bearing shell contacting the crankshaft journal, making it necessary to regrind the shafts.

"Due to this trouble and to avoid excessive repair costs, we developed on our railroad a crankshaft grinding machine that will grind the journal without removing the crankshaft from the engine. The machine has been loaned to various railroads having scored crankshaft journals, so as to avoid the removal of the Diesel engine from the power plant to remove the crankshaft for grinding.

"The machine will grind crankshaft bearing in from six to eight hours and does accurate work. It removes only such surface metal as is actually necessary. Grinding crankshafts in this manner should result in a service life of at least a million and a half miles, unless unforeseen breakage of the crankshaft occurs."

It is the practice of the Santa Fe to inspect the wheels under Diesel-electric passenger locomotives at each end of the road. Serious trouble from thermal cracks was experienced with some high-carbon wheels. Wheels now used have 3-in. rims and a chemical composition as follows:

	Per cent
Carbon	.57 to .70
Phosphorus	.016 to .028
Manganese	.63 to .72
Silicon	.23 to .28
Sulphur	.020 to .024

Over a period of about two years these wheels have averaged 84,000 miles between turnings and their life has averaged 250,000 miles.

Some axles, Mr. Morris said, have made over 600,000 miles. A few axles have been found defective, with cracks in the wheel seat after 350,000 to 400,000 miles. This is a serious condition and axles are being magnafluxed each time they are removed.

Difficulties have been experienced with every type of piston tried, he said. Piston troubles develop when the engines are working hard on mountain grades and in desert territories where temperatures are high. Cylinder heads crack across the valve bridges, in many cases because water ports in the heads were partially stopped up with scale. Removal of the scale reduced these failures at least 50 per cent. The heads are reclaimed by welding.

"In order to properly handle the maintenance of Diesel locomotives," said Mr. Morris, "we have erected a Diesel locomotive shop at Chicago which is 321.8 ft. long and 112.5 ft. wide, which will accommodate eight 1,800-hp. Diesel locomotives. It is equipped with a Whiting hoist for raising Diesel locomotives to remove trucks and an overhead crane to be used in connection with the handling or dismantling of trucks, removing many parts of Diesel locomotives, including the engine, steam generator, or main generators. Suitable drop tables have been installed so that individual wheels may be dropped when necessary to accomplish this work. Adjacent to the drop pits a wheel lathe will be installed so that power truck wheels can be machined without delay. In addition to the wheel pit and wheel-lathe facilities, the shop is to be divided into three sections, one section for machine tools; one section for repairing and reconditioning cylinder heads, piston assemblies, oil pumps, water pumps, cylinder liners, governors, and all other parts of Diesel locomotives that will require attention; another section will be used as electrical department to take care of all electrical equipment on passenger cars and Diesel locomotives.

"We expect to have the shop completed by the first of August and new machine tools will be installed as are necessary.

"For protection power between Chicago and La Junta, a distance of 992 miles, we have six 4-6-4 type oil-burning locomotives, 300 lb. boiler pressure, 84-in. drivers, and from La Junta to Los Angeles, a distance of 1,235 miles, we have eleven 4-8-4 type oil-burning locomotives, 300 lb. boiler pressure, 80-in. drivers. These locomotives average approximately 17,000 miles per month and are available to protect high-speed trains."

Mr. Wiles said that the B. & O. has had one 300-hp. Diesel-electric switching locomotive in light service on a pier, since 1925, one 600-hp. Diesel-electric switching locomotive, since 1936, and one 1,800-hp. single-unit passenger locomotive since 1935. The larger switching locomotive has worked 18,650 hrs. without general repairs or major replacements. The road locomotive has accumulated 560,000 miles, handling a load of 545 lb. per horsepower.

Six double-unit 3,600-hp. passenger locomotives, in service since 1937 and 1938, are assigned to runs of 448 to 771 miles a day, formerly handled by steam locomotives. They have accumulated a total of 2,000,000 miles with loads up to 894 lb. per horsepower with 14 Pullman cars, he said. Their availability has been 93.2 per cent.

Special facilities, he said, are provided at the terminals of Diesel-electric locomotive runs, for servicing. Work during layovers includes changing wheels and traction motors, washing steam-heat boilers, monthly, annual and other routine inspections and tests. He said that progressive re-conditioning of the Diesel engines is also taken care of at terminals daily, on a schedule such that all cylinder heads, pistons and liners will have been removed and reconditioned within 50,000 miles. Work requiring lifting the locomotive or engine units is performed at the Mt. Clare shops.

"The first road locomotive mentioned," he said "has had some traction-motor armature-bearing failures, and some trouble with connecting-rod bearings shelling out, but practically no trouble with main bearings or pistons and rings. The last six road locomotives have had but one traction-motor armature-bearing failure, and two traction-motor axle-cap bearings heated, none of which caused any delay. But considerable trouble has been experienced with connecting-rod bearings shelling out, main bearings shelling out and some trouble with sticking of piston rings. The manufacturers have developed a new connecting-rod bearing which has given very good service to date, and the trouble with piston rings has been reduced considerably by the application of a new forged-type piston and regular inspection of rings through the liner scavenging ports.

"Little or no delay is occasioned whenever it becomes necessary to cut out one of the Diesel engines. This is dependent on the character of the railroad where this occurs and the load at that time.

"Some trouble has been experienced with traction motors, the majority of which has been traced to broken coils in the armature windings. This weakness of the motors is being improved

by the locomotive builders as they are returned to them. Traction motors are being removed for routine repairs every 200,000 miles. No armature shafts have ever broken and to date it has not been necessary to renew any pinions or drive gears for wear, although three have had broken teeth, but in no instance did they cause any delay, being found upon inspection at the terminal. This could set up a very bad condition inasmuch as the heavy grease used to lubricate the gear teeth could carry a piece of tooth between the gear and pinion and lock the wheels. A means of disengaging the motor armature from the wheel would be desirable.

"On the road locomotives molybdenum heat-treated wheels are used extensively, 36-in. in diameter with 2½-in. rim and A. A. R. standard tread and flange contour. An average of 250,000 miles of service has been obtained from these wheels with two turnings during this service. Axles used are of A. A. R. M-104-34, Class A, Specification, a number of which have been in service 450,000 miles. None have ever broken or been found cracked. The mounting of wheels is handled at the railroad's Mt. Clare shops.

"There have been two main-bearing stud failures, both of which were on engines without serrations in the main-bearing caps. Some of the engines have serrated main bearing caps and they show indication of less movement of the bearing cap. Some trouble is experienced with the main bearings showing fatigue spots and, if not renewed, shelling out.

"The upper needle bearings of the connecting rods are checked each time the rod is removed and any rollers found defective are discarded and the good ones are matched into sets within .0003 in. of each other by the use of a comparator.

"Approximately 150,000 miles is obtained between renewal of the lower connecting-rod bearings of the old or high-lead-content bearing, but these are being replaced with the later bronze-type bearing which is expected to give longer service.

"To date three crankshafts have been replaced, two of which were caused by failure of connecting-rod bearings, and one broke because of a manufacturer's defect in the shaft. The most wear that has been measured on any of the shafts in service is .004 in. and indications are that it will not be necessary to consider regrinding them until after 1,000,000 miles of service.

"Considerable piston trouble was experienced that was corrected to a great extent with the application of later design forged pistons and the intensive inspection of rings, when the second ring is often found to be sticking and ring lands broken. The engine builders are now recommending a new style lower connecting-rod bearing, grooved to supply more oil to the interior of the piston for cooling, which should further help the piston-ring condition.

"No cylinder liners have been reground over-size, although some are being accumulated for that purpose. Very few of these are from wear but are ones that have been scored when piston rings failed. The shoulder that develops in the liner above the ring travel is removed with a special reamer before the piston is removed from the cylinder to avoid fracturing the piston-ring land when the ring strikes the shoulder. Liners are removed for regrinding when wear at the upper portion of the liner exceeds .025 in.

"Considerable trouble was experienced with heads cracking at the valve bridge on account of the cooling system becoming air bound. This condition was improved by the application of vent pipes. Some few cylinder heads still crack at the valve bridges and some across the top at the injector opening. Close attention is given to regularly washing out the cooling system to remove scale that prevents proper dissipation of heat from the heads, liners and radiators.

"Very little fuel-injector trouble is experienced and when it develops during a trip, the injector is replaced or the cylinder made inoperative, the same as on the Burlington."

Mr. Wiles said that Diesel-electric locomotives operating between Washington, D. C., and Jersey City, N. J., are used to protect the longer runs from Washington, D. C., to Washington, Ind., and Chicago.

Following the presentation of the prepared discussions, there was a lively discussion from the floor. Tom Sawyer (American Locomotive Company) referred to Mr. Urbach's statement that pistons, piston rings, and cylinder liners are inspected each week and cited his own experience when, in 1926, pistons and liners were inspected but once a year and later only once in two years. Speaking of the fact that the Burlington has nine spare traction motors with only 34 in service, he suggested that the minimum requirements in this respect were based on the scattered locations of the runs and expressed the opinion that with 1,000 motors in service it might not be necessary to increase the number beyond the present nine.

In reply, Mr. Urbach said that piston inspection on switching locomotives is through the inspection ports. On passenger locomotives pistons are removed after 80,000 miles. Referring to Mr. Sawyer's comment on the number of spare motors, Mr. Urbach added that the stock of spare motors had been built up at a time when they were having a great deal of trouble with traction motors.

E. B. Hall (general superintendent motive power and machinery, C. & N. W.), recalled the various references to the cutting out of motors en route and inquired what was the crew assignment on these locomotives. Mr. Urbach said that cutting out traction motors was a shop job and that a motor failure required setting out the locomotive. He said that the Burlington locomotives are manned by an engineman and a fireman; that, at the outset, these men were picked for their evidence of interest in Diesel locomotive equipment. There are, he said, three supervisors of Diesel-electric and gas-electric equipment who work with this equipment the same as road foremen of engines do with steam locomotives. No other men are assigned to the trains, he said.

John Purcell (assistant to vice-president, A. T. & S. F.) said that a maintainer accompanies the locomotive on the Santa Fe and that, with this man on the locomotive, it is possible to change pistons and carry out other details of maintenance work en route.

Mr. Allstrand said that a mechanic was assigned to each road locomotive on the North Western. Inasmuch as they suspected at the outset that they might have electrical troubles, these men were chosen from among the electricians. He said these men are still assigned to the passenger runs on an eight-hour-day basis. In the new Chicago-Minneapolis Diesel-electric service he said that they do not contemplate assigning a maintainer.

Further Development of the Reciprocating Locomotive

As the result of failure to obtain unanimous approval of the theoretical power requirements and the number of locomotive driving wheels and cylinders required to haul a train of 1,000 trailing tons at a sustained speed of 100 m.p.h., as covered by specifications in our first progress report, following discussion by the General Committee at the meeting June 29, 1938, it was decided that the Committee on Further Development of Reciprocating Steam Locomotive should be continued and it was instructed by the General Committee to work up plans for testing the latest types of steam locomotives, using a dynamometer car where necessary, and to submit recommendations to the General Committee.

Consequently, your committee worked up plans to conduct tests on the Pennsylvania, Chicago & North Western and Union Pacific on level tangent track at speeds of 100 m.p.h., using a trailing load of 1,000 tons. These test runs were made in October, 1938, and the data collected were assembled in report form. This report and the recommendations of your committee contained therein were approved by the General Committee at its meeting March 24, 1939, and, because of its importance to member lines who might be considering the acquisition of new locomotives, it was decided to distribute the report in advance of the regular annual meeting. This has been done and the report is now in the hands of all member roads.

The committee recommends that the above mentioned A. A. R. Passenger Locomotive Test Report be printed in the 1939 proceedings as a permanent record.

With further respect to this report, the committee respectfully calls particular attention to recommendations resulting from these tests contained in report of Subcommittee No. 2 which becomes a part of this report.

The following divisions of the committee, namely: Subcommittee No. 1—technical, subcommittee No. 2—cylinders and valves, subcommittee No. 3—boiler, subcommittee No. 4—design, are now engaged in formulating recommendations for a general design of proposed locomotive capable of meeting the demands

indicated as necessary by the road tests which, incidentally, closely approximate the estimated requirements incorporated in Progress Report No. 1, viz.,

1—4,000 drawbar horsepower as required for a 1,000 ton trailing load at 100 m.p.h. sustained speed.

2—Cylinder h.p.—6,400.

3—Four-cylinder engine.

4—Approximately 300 lb. boiler pressure and 750 deg. F. steam temperature at the boiler.

5—Conventional radial-stayed type boiler.

6—Factor of adhesion, 4.5 if possible.

7—Boiler to be able to supply 100 per cent cylinder demand plus steam demand for auxiliaries.

8—Calculations to be based on bituminous coal having 12,000 B.t.u.

9—Design of locomotive to be of conventional type, with provisions for streamlining.

10—Driving-wheel arrangement to be 4-4 coupled.

11—Engine designed for maximum curvature of 18 deg.

12—Driving-wheel diameter of 84 in. preferred.

13—Anti-friction journal bearings throughout.

The committee now has under consideration a project anticipating the use of a locomotive for experimental purposes in connection with proving or disproving various recommendations for the improvement of existing locomotives and incorporating in the design of new steam locomotives. Further information regarding this will be forthcoming at a later date, probably some months hence.

Particular reference is called to report of Subcommittee No. 1 with respect to recommendations concerning the question of counter-balancing of locomotives. In order to give this important subject the necessary attention the committee has appointed a special subcommittee composed of the following: W. I. Cantley (chairman), mechanical engineer, Mechanical Division, A. A. R.; E. G. Young, professor, University of Illinois, Urbana, Ill.; Lawford H. Fry, railway engineer, Edgewater Steel Company, Pittsburgh, Pa.; A. J. Townsend, Lima Locomotive Works, Inc., Lima, O.; H. Glaenzer, vice-president, Baldwin Locomotive Works, Philadelphia, Pa.; J. G. Blunt, mechanical engineer, American Locomotive Company, Schenectady, N. Y.; W. R. Elsey, mechanical engineer, Pennsylvania, Philadelphia, Pa.; K. Cartwright, mechanical engineer, New York, New Haven & Hartford, New Haven, Conn; H. H. Lanning, mechanical engineer, Atchison, Topeka & Santa Fe, Topeka, Kan.

This subcommittee has already started to function and it is hoped will be in position to make recommendations within a few months.

Subcommittee No. 4—Design, will be in position to make available a general drawing covering a tentative design of proposed locomotive capable of hauling a 1,000-ton train at a 100 m.p.h. sustained speed on tangent level track. This design will be forthcoming in the near future, at which time it will be made available to the full membership of the association.

The committee gratefully acknowledges the invaluable assistance and the cooperation extended by those who have participated in its work, particularly the Pennsylvania, Chicago & North Western and Union Pacific, which furnished the equipment for the test runs and over which lines the tests were made.

Report of Subcommittee No. 1—Technical

The entire question of counterbalance is in a chaotic condition. Quoting from a letter written by Mr. Cantley to Mr. Ellis on April 26, 1939: "As you will recall, there was a recommended practice of counterbalancing locomotives adopted in 1931*, but in 1934 the Committee on Locomotive Construction reviewed this matter, and included in their revision the cross-balancing of the intermediate drivers.** Since 1934, operating conditions of steam locomotives require schedules for considerably higher speeds than were required prior to 1934, and operating at these higher speeds of necessity requires more refinement in counterbalancing. . . . This has been demonstrated over the past year or more through some tests made by several roads at very high speeds." In view of these conditions and our own study of the conflicting processes now used in balancing, this subcommittee proposes to prepare a "primer" or "textbook" on counterbalance, in which there shall be set forth, with fully calculated examples, a full theoretical treatment of the dynamic counterbalance procedure, which after approval by the main committee will be used in analyzing the balance conditions of several existing engines, and which may be of assistance to the new counterbalance committee elsewhere referred to.

Further, in view of these conditions, this subcommittee placed before the main committee the recommendation that it recommend to the General Committee of the division a series of tests under service conditions designed (a) to determine the portion of the reciprocating weight, in terms of the weight and length of the locomotive, which may remain unbalanced, and (b) to determine the absolute merit, in terms of locomotive riding and rail effect, of various methods of balancing.

[The chairman of this subcommittee is E. C. Schmidt.]

* Based on Mr. Riegel's Subcommittee report in the 1930 Proceedings, which dealt with the main driving wheels only.

** This is further explained in the last paragraph on page F-140A-1935 of the Mechanical Division Manual which reads: "In cases where there are two main wheels such as the locomotives whose main rods are coupled to the main side rods, the second pair of main drivers should be cross-counterbalanced as well as given its portion of reciprocating balance as is done with the conventional type of coupling."

Subcommittee No. 2—Cylinders and Valves

On May 1, 1939, at Pittsburgh, Pa., Subcommittee No. 2, with full membership attendance, held a joint meeting with Subcommittee No. 1.

The purpose of the meeting was to report on a proposed new valve gear and poppet valve design. The committee had before it a statement giving full information in connection with this proposed valve gear and poppet valve design based on cylinders 21¼ in. by 26 in. Similar information was also shown for a 12-in. piston valve operated by a Walschaert valve gear.

The joint committee discussed this information with relation to the problem of obtaining more efficient cylinder performance, particularly at high speeds. The conclusions reached are given below.

Ratio of Expansion

High cylinder efficiency requires a high ratio of expansion, which means a short cut-off. With conventional valves and valve gears the limit of satisfactory operation is reached when the cut-off is shortened to about 25 per cent. If shorter cut-offs are tried the early release operates against full expansion and the early compression leads to excessive compression pressures.

The information available regarding the new type valve gear and valve design indicates that with a cut-off of 15 per cent, or perhaps even less, a satisfactory sequence of valve events can be obtained. The resultant high ratio of expansion should give a correspondingly high degree of cylinder efficiency. The mechanical problems involved in operating with short cut-offs were discussed. It was concluded that there does not seem to be any practical or theoretical objections to the use of a 15 per cent cut-off on a locomotive. This view is supported by stationary and marine engine practice.

Water Rate

The high ratios of expansion obtainable with poppet valves and special valve motion will produce high cylinder efficiency. It is believed that it should be possible to design cylinders to operate at 400 r.p.m. (100 m.p.h. with 84-in. drivers) with a water rate of 14 lb. of steam per h.p.hr. With conventional cylinders, valves, and valve motion a water rate of 15 lb. per indicated horsepower per hour is considered to be good practice.

Cylinder Design

To obtain full benefit from improved valves and gears, all steam passages must be carefully designed. Ample cross-sectional area must be provided for the free flow of the steam from the boiler through the superheater and steam pipes to the steam chests. The steam-chest volume must be large and the cylinder passages smooth and of large area so that the quantity of steam required for maximum cylinder demand can be delivered without undue loss of pressure. The exhaust passages must also be of

ample cross-section so that the steam may be evacuated without building up unnecessary back pressure.

Limitations on Cylinder Horsepower

Analysis of the performance of the locomotives used in the A. A. R. passenger locomotive tests of October, 1938, shows that the maximum cylinder horsepower was reached at speeds of 370 to 390 r.p.m., 70 to 80 miles an hour. At higher speeds the cylinder horsepower dropped off. The peak horsepower corresponds to a definite rate of steam flow through the steam passages. The speed could be increased by increasing the rate of steam flow, but this entails greater frictional losses. These losses cut down the initial pressure and increase the back pressure so that the mean effective pressure is reduced. To maintain these higher speeds the load must be reduced so that the locomotive operates at a lower cylinder horsepower rate.

The joint committee points out that over-all locomotive efficiency can be improved and the speed at maximum horsepower can be raised if ample valve openings are obtained and if all cylinder passages are designed for a free flow of steam.

Recommendation

In presenting this report the joint subcommittees express the opinion that they have carried their study of the subject as far as they can go by theory alone. It has been shown that it should be possible to make considerable improvement over the efficiency obtainable with conventional cylinders and valves. The next step is to demonstrate this improvement in practice.

The joint subcommittee recommends strongly that the A. A. R. Mechanical Division be asked to carry out tests of a locomotive fitted with improved cylinders, valve gear and poppet valves. Such tests would show the advantages to be obtained from high ratios of expansion and unrestricted steam flow.

[The chairman of subcommittee No. 2 is Lawford H. Fry.]

Report of Subcommittee No. 3—Boilers

The subcommittee made a study of the comparative advantages of Belpaire vs. radial-stay type back-end construction. It also considered the barrel-type combustion chamber with moderate depth of throat sheet vs. shallow throat sheet with a long firebox equipped with a Gaines arch.

In studying the steam rating for the boiler, we considered available data from Pennsylvania tests, from the C. & O. and from the New York Central Gardenville test, and designed a boiler for 105,000 lb. of steam per hour on the basis of no allowance for the feedwater heater, for coal with 12,000 B.t.u. and for a reasonable rate of combustion with a horizontal mud ring to obtain a level grate.

The subcommittee accordingly prepared a preliminary boiler design which has been sent to the chairman, Subcommittee No. 4. This design is based on an assumed evaporation of 5.4 lb. of water per lb. of coal and an evaporation of 20.6 lb. of water per sq. ft. of heating surface, which will mean a coal consumption of 19,500 lb. per hour and 152 lb. per sq. ft. of grate per hr.

Our committee has discussed possible improvements in boiler performance of existing locomotives rather informally and offers the following comments:

1—The addition of brick arches and superheaters to existing locomotives which were not so equipped has been done to a very general extent and there are probably few existing locomotives now without these accessories to which their application would be justified. We have considered various forms of circulating devices in fireboxes and believe that further experience in actual service may warrant some definite recommendations later on.

2—We have had some discussion on suggested basic modifications in the design of brick arches and superheaters, but do not feel that the time is ripe for definite recommendations.

3—Possible changes in connection with improvement in the cross-sectional area of dry pipe, throttle pipe and steam passages would, no doubt, in many cases reduce the drop in steam pressure at the cylinders and the committee feels that studies of this character would in specific cases be worth while, but as yet, no definite recommendations are made.

4—We are informed that an experimental application of an automatic stoker discharging fuel into the firebox from the front end instead of the rear is showing good results and reducing cinder cutting very materially. This application, however, is still in a preliminary stage and no definite report can be offered at this time.

5—In connection with the use of automatic stokers a definite check-up on the type of grate bars may result in fuel saving and better combustion.

A comprehensive study of drafting arrangements in the smokebox might also result in suggested changes that would improve combustion and improve the steaming qualities of existing boilers.

[The chairman of this subcommittee is J. B. Ennis.]

The report was signed by D. S. Ellis (chairman), chief mechanical officer, Chesapeake & Ohio; W. I. Cantley (vice-chairman), mechanical engineer, mechanical division, Association of American Railroads; W. R. Hedeman, engineer tests, Baltimore & Ohio; J. E. Ennis, engineering assistant, New York Central; W. R. Elsey, mechanical engineer, Pennsylvania; J. M. Nicholson, mechanical superintendent, Atchison, Topeka & Santa Fe; Lawford H. Fry, railway engineer, Edgewater Steel Company; W. E. Woodard, vice-president, Lima Locomotive Works, Inc.; H. Glaenzer, vice-president, Baldwin Locomotive Works; J. B. Ennis, vice-president, American Locomotive Company; E. G. Bailey, vice-president, Babcock & Wilcox Company; and Edward C. Schmidt, professor of railway engineering, University of Illinois.

Discussion

Representatives of the three steam locomotive builders who were invited to discuss this report united in emphasizing the importance of the proposed road tests which will serve as a definite basis for recommendations regarding such important locomotive details as counterbalancing, new types of valve gear, valves, etc. W. H. Winterrowd, vice-president, Baldwin Locomotive Works, said that the report is a valuable contribution to progress in locomotive design and suggested that arrangements be made to keep the proposed textbook on counterbalancing up to date so that it will be of maximum value for reference purposes. He requested that the committee clarify its meaning whenever reference is made to the length and weight of a locomotive to indicate whether the tender is included, as tender weight may be given consideration under certain conditions in deciding what proportion of the reciprocating weights must be balanced.

Mr. Winterrowd said that the poppet-type valve as now developed looks promising, especially when combined with suitable design for a minimum pressure drop in the steam pipes and minimum back pressure. He also referred to the desirability of having locomotives designed for a large cruising radius and maximum availability. He said that further substantial improvements in steam locomotives are now under way and that, for best results, high capacity and reliability of performance must be combined with relatively low first cost and maintenance expense.

J. B. Ennis, vice-president, American Locomotive Company, said that reciprocating steam locomotive design has made important advances in recent years and that still further improvements can be made. He stressed the importance of laboratory research, supplemented by road tests of various important parts of steam locomotives, particularly in view of the lack of complete performance data covering these various details at speeds of 80 to 100 m.p.h.

Mr. Ennis called attention to the formulae used in calculating locomotive horsepower and said that "They represent what would be expected from a locomotive 15 or 20 years old, but, today, they are very much on the conservative side and the modern passenger locomotive develops its drawbar horsepower at considerably higher speeds than indicated by these curves. Furthermore, it maintains its power at a better ratio than shown at the higher speeds. No criticism should be offered as to the use of these formulae in this case, for the reason that no universally accepted formula is in use today for determining the horsepower for modern locomotives. All of the methods in use for the calculation of steam locomotive horsepower, with which I am acquainted, indicate that much better performance could be expected. This is also borne out in the report by the partial curves of actual drawbar horsepower produced by the three locomotives tested, the peaks in these cases being apparently from 50 to 60 m. p. h. Comparisons between these calculated curves and the information given with respect to indicated horsepower should

be most carefully made in order that one does not draw erroneous conclusions. Again, this emphasizes the necessity of securing additional test data under conditions of high-speed operation, and it is hoped that such tests can be made and full dynamometer and indicator records obtained." He also said that a study should be made of important locomotive details which give promise of improvement and suggested tests to determine actual net results, bearing in mind that desirable reductions in steam and fuel consumption should be secured but not at the sacrifice of availability or low maintenance cost.

W. E. Woodard, vice-president, Lima Locomotive Works, Inc., complimented the committee on its constructive work which he said will have a decided influence upon future improvements in steam motive power. He indicated that several potentially important developments in locomotive design are either ready for the testing stage, or nearing that point. Laboratory tests, conducted under proper conditions, may supply information which will save a large amount of time and expense when the test application stage is reached.

Mr. Woodard referred to certain experience gained in laboratory tests in connection with the poppet-valve development referred to in the sub-committee's report. He said "In operating the apparatus on the block tests for observation, it was soon found that it is absolutely essential to produce the various parts of the motion by precision methods and use anti-friction bearings throughout in order to secure a mechanism which, at speeds up to 120 m. p. h., will not deflect or have lost motion. Distorted valve events at high speeds is one of the limitations of our present form of valve motions and it became evident early in our laboratory tests that such refinements were required to avoid distortions in the new gear. I mention this as an example the refinements which are going to be required in further design developments."

In closing his remarks, he referred to the subject of locomotive back pressure as influenced by exhaust-passage design and said that tests, carried out by releasing definite volumes of air at varying pressures through different forms of exhaust passages cast from plastic wood, have provided useful and interesting information. Also that the results are being incorporated in a set of cylinders now under construction. Mr. Woodard referred to these subjects only as examples of improvements which may well be tests in the experimental locomotive referred to in the committe's report.

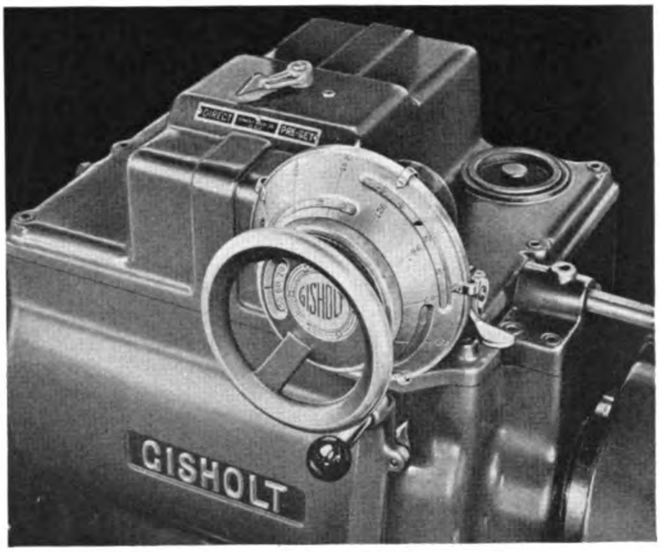
(The report was accepted and ordered printed in the proceedings.)

Gisholt Speed Selector

The Gisholt Speed Selector, illustrated, has been developed recently for obtaining easily and quickly any one of the 12 available spindle speeds on Nos. 3, 4 and 5 ram-type universal turret lathes, made by the Gisholt Machine Company, Madison, Wis. The device is power driven and the operator simply sets a dial and the machine automatically makes the shift to give the correct spindle speed. The Speed Selector is particularly useful in keeping machines running and tools cutting at most efficient speeds.

Very often production is low because operators dislike to change speeds for varying diameters of work, especially if much effort is required. The Speed Selector makes speed changing (and speed selection) so easy for the operator that he will enjoy changing to the right speed. This helps to keep machines running at the most efficient cutting speeds at all times and is said in some instances to have increased production 50 per cent.

The Gisholt Speed Selector provides three types or methods of operation. The one used depends upon the particular work at hand. The first is the "Direct" method of operation where spindle speeds are changed simply by turning the dial to the desired spindle speed or to the diameter of the particular cut being taken. Immediately upon making this setting, the machine automatically makes the shift and the spindle rotates at the desired speed. The dial is conveniently located at the front of the headstock and close to the work where it is well within the operator's range of vision. All numbers on the dials can be easily read at a glance. It is also within the normal operating zone and the operator may set the dial with his left hand while indexing the turret with his right hand. Thus, the time for changing speeds is absorbed in the regular machine operation which results in a further increase in production.



Speed Selector which greatly facilitates the use of correct spindle speeds on Gisholt Nos. 3, 4 and 5 ram-type universal turret lathes

The second is the "Pre-Set" method where the desired spindle speed for the next cut may be selected and preset in advance of the actual speed change. That is, while one cut is in progress, the speed for the next cut may be selected by turning the dial. The speed change is then instantly made by merely touching the trip. The actual shifting is done automatically by the machine. Here again the time for speed changing is absorbed during the cutting operation.

The third is the "High-Low" method which may be used at any time in conjunction with either the "Direct" or "Pre-Set" operation. This method provides a quick change between high and low speeds and vice versa. On most work, a high spindle speed is required for drilling, boring, turning or facing and a low speed for threading, tapping, forming or reaming. When the machine is operated in any one of the six high speeds by merely pressing the trip a corresponding low speed is instantly produced. The machine may be returned to the high speed by lifting the same trip. All spindle speed changes are made without stopping the spindle or releasing the main drive clutch.

The hand wheel controls both the inner dial and the outer dial. The 12 available spindle speeds ranging from 28 to 730 r. p. m. are marked on the outer dial. The work diameters from 1/4 in. to 12 in. are marked on the inner dial and may be seen through the slots in the outer dial. The work diameters are graduated in small increments for both bar work and chucking work so that the most efficient spindle speed may be easily determined at a glance.

The cutting speeds, which range from 40 to 600 ft. per min., may be seen through the opening at the front of the hand wheel. In operation, the proper cutting speed for the particular metal being turned and the tools used is set on this dial by means of the knurled wheel. After this is once set, it is not necessary to change it

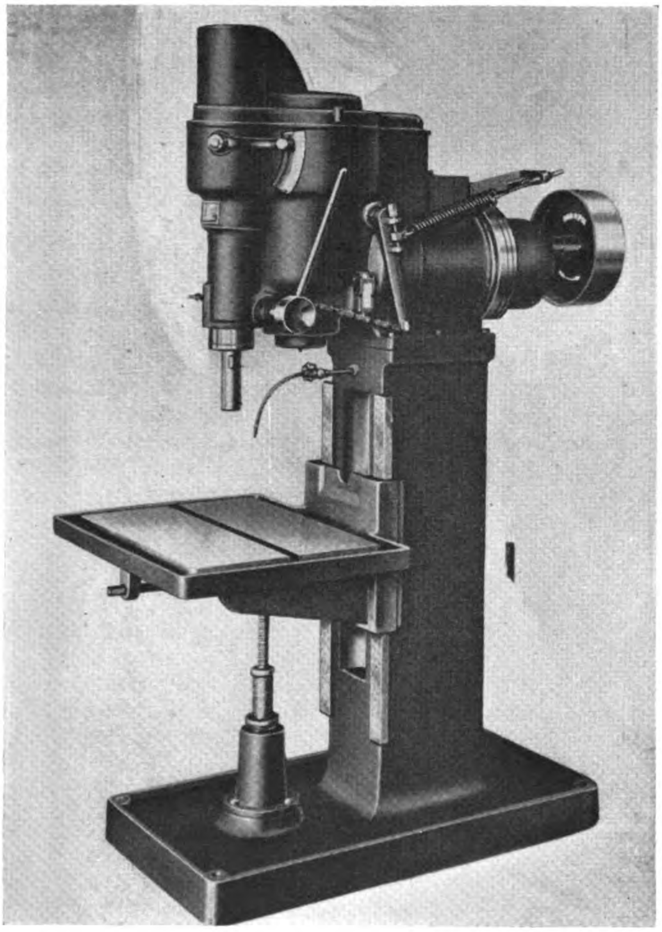
until working on a different metal or with different cutting tools which require more or less feet per minute cutting speed for efficient cutting and for long tool life.

Therefore, any adjustment of the cutting speed produces a corresponding change in the relative position of the diameters, and the most efficient cutting speed will be maintained at all times for each diameter of work by merely turning the dial to that diameter. It can be readily seen that it is not necessary for the operator to stop and deliberate or calculate which will be the most efficient speed for the next cut. Nor will he have to depend upon trial and error method for selecting the proper cutting speed. The speed selector does all that for him and all that is necessary is to turn the dial to the diameter of the cut and the machine will be operating at its top efficiency.

Hi-Duty Nut Tapper

Several new patented features of construction have been incorporated in the line of Gaterman tapping machines which was recently purchased and will in the future be manufactured by the L. J. Kaufman Manufacturing Company, Manitowoc, Wis. For example, the new Hi-duty nut tapper has been designed to operate on the same principle as hand tapping, but with far more sensitivity, as the working strain is weighed to a fraction of an ounce. It is claimed that the absence of unreliable friction adjustments positively prevents tap breakage.

This machine is made in two sizes. The No. 5 will handle 1/4-in. to 3/4-in. taps in steel and the No. 10 from 5/8-in. to 1 1/2-in. taps in steel. Larger taps can be handled in materials such as cast iron, aluminum, magnesium, and plastics. The drive mechanism is fully geared and enclosed in an oil-tight housing. Complete automatic lubrication is attained by splash and force-feed systems. Any necessary adjustment to clutches or internal mechanism may now be made from the outside without removing the spindle or clutch assemblies. Two levers govern the 4-speed geared transmission of the No. 5 machine and the 6-speed transmission on the No. 10 machine.



Hi-duty nut tapping machine designed for high production without tap breakage

Tapping-torque pressure can be controlled or adjusted while the spindle is in operation. Lead screws can be furnished which permit holding the true tap pitch in any material. This is sometimes wanted in soft materials such as plastics, or when threads are to start in a definite relation with the surface or with mating parts. For instance, it is said that a steep taper thread tap can be run in and out of a hole a dozen times without damaging the thread cut in the first pass.

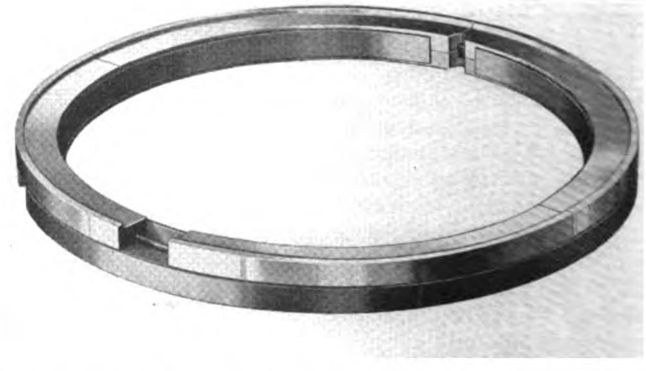
Sectional Bronze-Iron Packing For Locomotive Valves

The Koppers Company, American Hammered Piston Ring Division, Baltimore, Md., has developed a sectional bronze-iron packing ring for piston-valve cylinders. The valve packing consists of bronze and cast-iron segments, steel restraining ring, and a steel expander. It is similar in construction and design to the sectional bronze-iron flanged main cylinder packing made by this company.

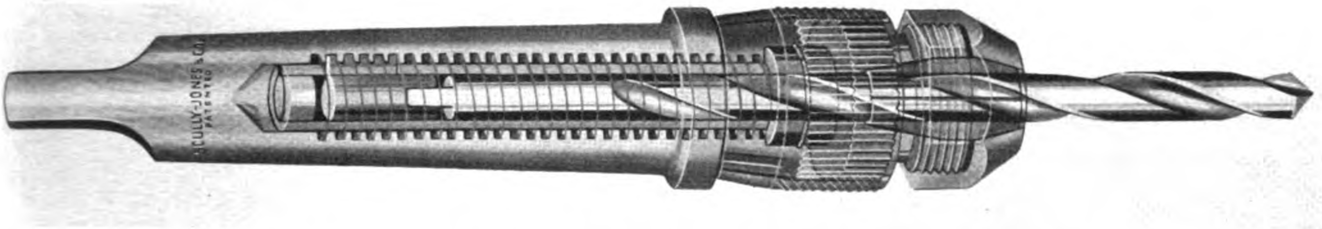
The diameter of the valve is considerably less than the diameter of the valve bushing, and the flanges of the packing rings extend across the face of the valve so that the valve rides on the packing ring and is thus protected from wear. The same valve may be used in standard and oversize bushings, the difference in size being taken up by an increase in the thickness of the packing-ring flanges.

The tension on the bronze-iron sectional valve ring is supplied by an expander made of heat-resisting alloy steel which presses the bronze-iron rings outwardly against the bushing with a constant and comparatively light pressure.

The flexibility of the segmental construction makes the packing ring adapt itself to the contour of the cylinder which is out-of-round or tapered. As only the packing comes in contact with the valve bushing, there is no wear on the valve. These packing rings are free to rotate in the grooves. The restraining ring prevents joint alinement and prevents the segments from springing out and catching on the ports of the valve bushing.



Koppers American bronze-iron packing for locomotive valves



Drill chuck designed so that the drill may be fed out as desired by a screw arrangement

Feed-As-You-Need Chuck

A new Feed-As-You-Need chuck has recently been developed by Scully-Jones & Company, Chicago, which is of ingenious and rugged construction, designed to hold a drill within the chuck body and feed it out by means of a screw arrangement as shown in the illustration. This permits the operator to adjust the drill so that it will go through the work and the drill bushing. With this method of holding and driving drills, there is a tendency to reduce or eliminate breakage because of the shorter grip.

The Feed-As-You-Need chuck can be adapted to drilling, counter-boring and spot-placing to a given depth with the use of the proper combinations. In multiple-spindle machines, all drills can be adjusted to project the desired distance from the spindle. The chuck is made with either Morse taper or straight shanks, and at present is furnished only for drills up to 7/16-in. size, with 4½ in. in maximum projection.

Drills with broken shanks, tips, etc., can be salvaged and reused by the use of this chuck. All that is necessary is to grind a flat on the drill to fit the slot in the chuck, and then adjust the drill to the desired depth.

Die-Cutting Band Saw

In 1935 Continental Machines, Inc., Minneapolis, Minn., placed on the market what was said to be the first all-purpose die-cutting band saw. The machine was made possible by the development of very narrow band-saw blades which came out about that time. Since then, these narrow saws have been developed to a still higher point of toughness and are made in still narrower widths.

As a die-making machine, the new Model V-36 band saw, is designed to cut shapes and contours in any metal or material. It cuts at the rate of 1½ in. per min. in 1-in. tool steel. In cast iron, it cuts 3½ sq. in. per min. Tilting the work table makes it possible to cut angles as well as contours in one operation. The saw blade leaves a slit only 1/16 in. wide and cuts the toughest stainless and high-carbon steels, as well as aluminum, brass, plastics and the softer substances. The saws cost about 80 cents per band, and are designed to last for over 600 sq. in. of cutting. For internal cuts saws are instantly welded into bands with an automatic butt welder in the machine.

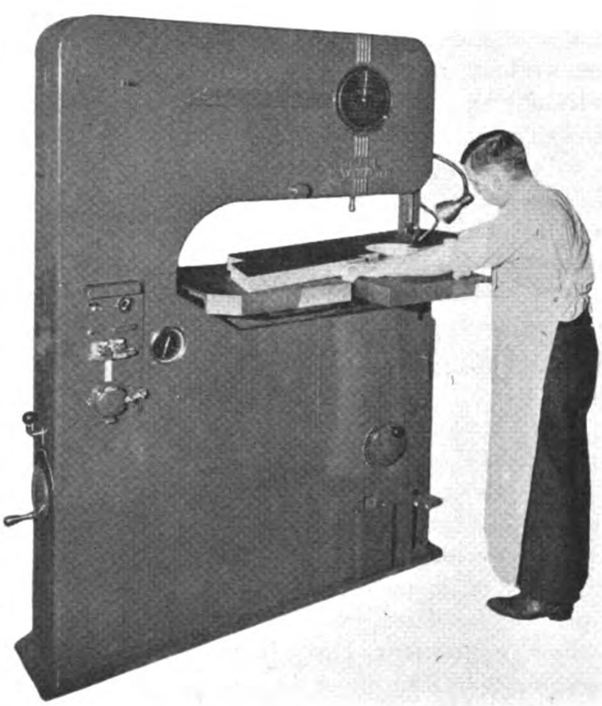
The new machine is massive and rugged in construction. It has a 36-in. throat and 10-in. work height capacity. It is built of arc-welded steel, and the housing also serves as the frame of the machine. It weighs 1,775 lb., complete. The work table tilts in four directions, is 30 in. square and 2½ in. thick, of box type construction.

A 1-hp. motor drives the machine, first, through special Bakelite pulleys which give infinitely variable speed, and then through a silent transmission. The transmission contains eight helical gears, which run in oil. A speed range from zero to 1,500 surface ft. per min, is available in this machine, and a tachometer dial is conveniently located to indicate the exact speed. The correct speed to use for contour sawing is shown on another dial on the machine, which is called the job selector.

A ¼-hp. motor drives a small grinder wheel, mounted in the panel just under the automatic butt welder for removing the flash of the weld on the saw bands. An entirely new type of saw guide has been developed for this machine which holds the back of the saws more securely and closer to the work both below and above the work table. These guides are adjustable for wear.

A new piston-type pump is employed for the air jet, which keeps chips from accumulating at the point of work. Ball bearings are used throughout the entire machine at wearing points. Furnished with this new model is a three-power illuminated magnifying glass for close work, 20 saws, two files, and three polishing bands. The electric wiring is centered in one built-in junction box, and each machine is shipped ready to run.

This machine operates file bands and polishing bands for jobs that require high finish after the sawing operation. The Doall is basically a shape-cutting machine, using narrow band saws, but it is possible to use abrading bands in addition to the saw bands. It is said to take only a minute to change bands.



The Doall Model V-36 all-purpose die-cutting band saw

EDITORIALS

Labor-Saving Versus Labor-*Serving* Machinery

Does modern high-production machinery which saves such vast amounts of manual work in many manufacturing and maintenance operations really harm labor by reducing the number of jobs available, or does it help labor by increasing the number of jobs in the aggregate, raising rates of pay and improving the general standard of living? In other words, is modern labor-saving shop machinery a detriment, or is it truly labor-*serving* in the broadest sense of the term?

A discussion of the more or less involved and interrelated aspects of this question may well be left to experienced economists, but the fundamental consideration seems to be fairly clear. It simply is not true, as too many people believe, that a given machine which doubles the output per man cuts employment in half, and endless examples may be cited to controvert this statement. The automotive industry is frequently mentioned as a shining example of mechanization which vastly multiplies both output per man and total employment. Similarly, spinning and weaving machinery in this country is said to produce more cloth annually than the entire working population could make, laboring 365 days a year and using the spinning and weaving methods of the early American colonists. If this modern textile machinery is not labor-*serving,* why not scrap it in the interests of the national welfare? Simply because it gives employment to about 2,000,000 American workers, as compared to a negligible number in India, for example, which still makes cloth largely by hand-weaving methods.

A discussion of machinery and the American standard of living, recently published by the Machinery and Allied Products Institute contains the following pertinent statements: "The highly developed technological society in America has provided more jobs in proportion to population than have been provided outside of agriculture in any society in the world of which we have record.

"In 1870 about 32 per cent of the population of the United States was gainfully employed, according to the United States census. This figure rose decade by decade. In 1930 it was about 40 per cent. Even in the years of the most severe depression in the 1930's the percentage of the population employed was higher than in periods considered prosperous prior to 1900.

"Few occupations have been affected more by mechanization than those in the manufacturing and mechanical industries. Yet, employment today in these industries is almost four times as high as in 1870, whereas population is less than two and one quarter times as large as in 1870. During this period, fifteen major manufacturing industries have been developed as a result of technological advance. They provide direct employment for approximately 1.5 million workers."

And what does all this have to do with running a railroad shop or enginehouse? Simply this—Mechanical department appropriations for new work and even for necessary maintenance operations are definitely limited on most roads under present conditions, and any man-hours of labor saved by a modern machine in one operation are available for other badly needed work. In addition, it may be said that labor-saving machinery which reduces unit prices, increases wage rates and stimulates general employment has a highly-favorable effect upon railway car loadings and earnings, thus completing the circle and making possible the employment of additional railway workers. Improved modern shop machinery and equipment, when installed in railway locomotive shops, car shops and engine terminals, is therefore not only labor-saving, but labor-*serving.*

Accurate Wheel Work Of Increasing Importance

The advent of high-speed train operation in this country is rapidly bringing out into the open a number of problems that were not known or considered of great consequence when train speeds were in the lower ranges. Without doubt one of the most important of these is wheels and the railroads are now faced with the necessity of making a number of changes in practices and shop equipment for the purpose of correcting many existing difficulties and anticipating others that may develop in the future.

Like most other problems of a mechanical nature those which are related to the use of wheels under rolling equipment on railroads may be viewed from two standpoints—from that of design and manufacture and from the standpoint of maintenance. The latter category embraces the whole subject of wheel shop practice and it is upon that subject that this comment is directed—whatever problems there may be relating to manufacture seem to be very well taken care of by those upon whom the responsibility rests.

It has been said that the requirements for a good pair of wheels are rather simple; that the axles be accurately machined, the wheels exact mates, wheel bores concentric with the treads, the treads smooth and round with-

in close limits and the whole assembly mounted to gage and in balance. That these requirements are not so easily attained may be attested to by the fact that many roads are having troubles that, upon investigation, may be traced directly to faulty wheel-shop practices. It is significant that the A. A. R. Wheel Committee took occasion in this year's report to call the attention of the Mechanical Division members to the shortcomings of many roads in the matter of shop practice and included the rather startling statement that a recent survey disclosed the fact that out of 61 shops inspected only 44 per cent were rated as carrying on their wheel work in conformity with the standards set forth in the Wheel and Axle Manual.

In all fairness to the men who are responsible for wheel-shop work it should be said that it is surprising that there is not a great deal more inaccurate work turned out when the character of the equipment and tools with which they have to work is considered. Many important shops are trying to turn out good work with axle lathes, wheel lathes, boring mills and mounting presses that passed the peak of their economic usefulness several years ago. There is no excuse whatsoever for any road operating trains at high speeds to set a standard in wheel work that is anything less than the requirements of the Wheel and Axle Manual and it should be obvious, in many shops, that those requirements cannot be met with the tools and equipment now at the disposal of the workmen.

Aside from the question of the routine operations of wheel work there are two subjects now coming to the front that are worthy of the most careful consideration, namely; the grinding of wheel treads and the dynamic balancing of mounted wheels and axles. The grinding of wheels, particularly chilled-iron wheels, has been performed for a long time but it took high-speed train operation to direct attention to some of the faults that may be corrected and the advantages to be gained by grinding practice. With modern wheel-tread grinders it is possible to produce finished mounted wheels with treads of identical circumference, concentric with the journal and with a perfectly smooth surface for rail contact. Grinding also affords a means of checking the accuracy of the preceding fabricating operations. Advantages to be gained are a reduction of noise incident to wheel and rail contact, reduction of vibration and a reduction in the cost of maintenance of trucks and truck parts.

As for dynamic balancing, two roads, to our knowledge, are now balancing wheels by this method. It has been practiced in Europe for some time. There is, however, a wide difference of opinion, in this country, concerning this practice, with its opponents taking the position that the amount of unbalance likely to exist in passenger-car wheels is negligible, so far as its effect on the riding of the car is concerned.

Probably the most important thing in connection with wheels and wheel work is the fact that operation at speeds in the 60- to 100-mile zone has taken this subject out of the realm of the past, where somewhat rough practices were considered good enough, and projected it into a new field where the utmost in precision methods will be required to produce the results that both safety and comfort demand. The day of guesswork is gone. It is essential that those who are responsible for wheel work view every new development with an open mind and lend their support to whatever scientific research may be needed to develop the best practices.

Motive Power—Steam and Diesel

It is significant that the two items on the program at the Mechanical Division meeting held at New York, June 28, 29, and 30, which were best discussed, dealt with the operation and development of rival forms of motive power. The presentation of the paper on the operation of Diesel-electric locomotives by H. H. Urbach brought forth three prepared discussions as well as a lively and spontaneous exchange of questions and answers concerning various phases of the operation of Diesel locomotives in passenger-train service.

This paper presented an excellent opportunity for a free discussion of the general methods of operation and maintenance of Diesel-electric locomotives. It was the first opportunity for a discussion of operating costs, since there has been sufficient experience to give cost figures real significance. This applies to the Diesel-electric locomotives in switching service alone, however, as neither the paper nor the discussion dealt quantitatively or specifically with costs in passenger service.

The point most stressed in favor of Diesel-electric locomotives, both in switching and road passenger service, is the high percentage of availability and the relatively small amount of standby protection required. Some of its other obvious advantages are greater cleanliness, or at least freedom from cinders; its high rate of acceleration through the lower speed range; the uniform torque, and perfect rotating balance of its driving axles, and its ability to make long non-stop runs.

The report on the Further Development of Reciprocating Steam Locomotives brings into the open the constructive effort which is being made by the steam locomotive builders and, to some extent, co-ordinated by the Mechanical Division, toward the removal or setting back of limitations as to speed and capacity of the reciprocating steam locomotive for passenger-train service. Perhaps the two most important of these limitations now under consideration are counterbalancing and inadequate provisions for the inflow and outflow of steam at the cylinders.

It is a matter of interest, however, that the report does not deal with the advantages of the steam locomotive in comparison with its principal present competitor. What are they? Do they relate to operating convenience? This would not seem to be the case con-

sidering the general opinion of those who have had experience with Diesel locomotive operation that it is simpler to operate and service than the steam locomotive. While it requires the development of a different routine in the matter of maintenance, the evidence seems to indicate that there are no inherent difficulties which are greater in dealing with in this type of motive power than railroad men have long been accustomed to in dealing with steam motive power.

It would seem, then, that the advantages of the steam locomotive do not lie in the locomotive itself, but that they must be looked for in the field of ultimate economy. Here the obvious advantage of the steam locomotive is its much lower first cost per horsepower of rated capacity. Laying aside all questions of the relative availability of oil and coal as locomotive fuel, it would seem that, if the first cost per unit of capacity of the Diesel locomotive were to be reduced and the first cost of the steam locomotive were to be increased to a point where the two were equal, there would be little question as to which of the two types of motive power would be selected for road passenger service.

Aside, then, from the question of maintenance cost, which has not yet been clearly determined in road service, and the question of fuel availability, which at the moment is attracting no particular attention, the advantage of the steam locomotive lies almost entirely, if not exclusively, in its lower first cost. In connection with whatever refinements or changes in design and construction are contemplated, in furthering the development of the steam locomotive in the present competitive situation, therefore, the exploitation of this advantage should always be kept in mind.

Smoother-Operating Passenger Trains

A development of importance to the improvement of future smoothness of operation of passenger trains is dealt with in the report of the Committee on Couplers and Draft Gears presented at the Mechanical Division meeting held at New York, June 28, 29, and 30. This is the tentative proposal of general characteristics and limitations for a passenger-car draft gear which, if finally adopted, should do much to relieve the occupants of railway passenger vehicles from horizontal acceleration and deceleration shocks to which they are now frequently subjected. The feature of the gear which is likely to have most effect on this condition is the proposed limitation of initial compression to 3,000 lb.

The ideal draft gear or, indeed, an ideal cushioning device for any type of service is one which is smooth in its build-up of resistance to applied force from the moment the force begins to build up. Practically, so long as the initial compression to be overcome does not exceed the frictional resistance to movement, the effect should be entirely satisfactory.

The proposed initial compression of about 3,000 lb. is probably as low as it is practicable to go with assurance of maintaining a slack-free friction draft gear for a reasonable service period. Applied to cars with present conventional couplings, which do not completely control the slack, however, such a minimum will not protect the cars in a train from some shocks in the sudden change of acceleration due to the successive application of force to the cars in the train. Under certain conditions of starting and stopping the individual vehicles in the train would be subject to acceleration or deceleration rates varying from, say, 0.2 to about 1 ft. per sec. per sec. Such rates of acceleration or deceleration seem very low. The late Dr. C. F. Hirshfeld, in his investigations for the Electric Railway Presidents' Conference Committee, however, found that the rate of acceleration or deceleration which could be developed without discomfort, depended upon the rate of change of the rate of acceleration, rather than upon the total rate of acceleration finally reached. The difficulty with the rates of acceleration and deceleration developed as the result of initial compression is the rapidity with which they are developed.

If a draft gear of the proposed characteristics is applied to cars with tight-lock couplers, however, so that the amount of free slack between cars is practically eliminated and placed in control of the draft gear, the maximum accelerating or decelerating effect of the uncushioned force due to initial compression will be about 3,000 lb. applied to the entire weight of the train. With a train made up of ten cars each weighing 50 tons, for instance, the maximum effect would be scarcely more than an acceleration or deceleration rate of 0.1 ft. per sec. per sec. This would largely be offset by the total resistance of the train and the effect on the occupants of the cars would probably be satisfactory.

The combination of a draft gear meeting the general characteristics proposed by the committee with the tight-lock coupler promises a decided advance in the smoothness of passenger-train operation.

New Books

A. S. T. M. Specifications for Pipe and Piping Materials for High-Temperature and High-Pressure Services. *Published by the American Society for Testing Materials, 60 S. Broad st., Philadelphia, Pa. 128 pages; spiral-ring binding. Price, $1.25.*

Eighteen specifications covering carbon-steel and alloy-steel piping and tubing, castings, forgings, and bolting for central-station power plants or similar industrial installations of piping materials have been brought together in this reprint from copyrighted publications of the American Society for Testing Materials. Several of the specifications have been approved as American standards by the American Standards Association and a number have been adopted by the Boiler Code Committee of the American Society of Mechanical Engineers.

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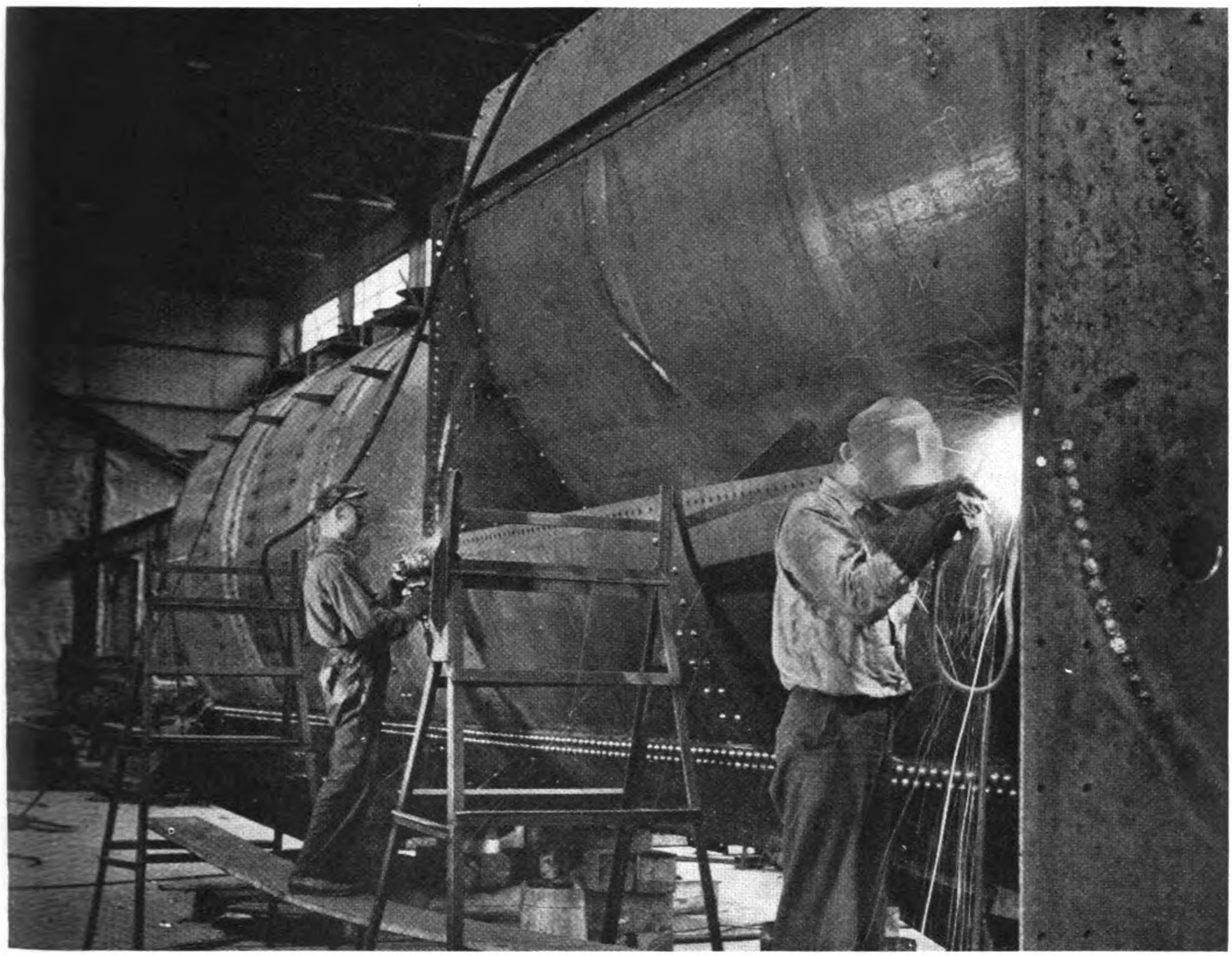
METHODS AND MACHINERY THAT GUARD LIMA QUALITY



TIGHT TANKS

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LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

High Spots in

Railway Affairs . . .

Motor Transport Continues to Grow

The Interstate Commerce Commission's Bureau of Statistics and Bureau of Motor Carriers reports that Class 1 motor carriers of passengers reported March revenues of $7,659,598 as compared with $7,052,867 for March, 1938, an increase of 8.6 per cent. The number of passengers carried increased 11 per cent, from 9,554,965 to 10,457,676. It is significant that the non-commutation passenger revenues of the railroads were less than 1 per cent greater in March this year than in March last year, and the railroad passengers carried were 12 per cent fewer than in March of last year. The American Trucking Associations report that 212 carriers in 37 states showed total loadings of 1,072,301 tons during May, as compared with 968,874 tons in April and 808,088 tons in May of last year. The May figures this year mark the highest movement of revenue freight by motor trucks in any single month since January, 1938, when the statistics were first compiled.

Harriman Safety Awards

In contrast to the Railroad Employees' National Safety Contest, held under the direction of the National Safety Council, which awards medals each year for the best record for safety to employees, the E. H. Harriman Medals are awarded for the best safety performance, based upon the accident records as a whole as compiled by the Interstate Commerce Commission. This award was established by Mrs. Mary W. Harriman in 1913, in memory of E. H. Harriman. It is continued now by W. A. and E. R. Harriman, sons of E. H. Harriman, and is sponsored by the American Museum of Safety. The Norfolk & Western received the gold medal for the best 1938 safety performance among the larger railroads. It has reduced passenger casualties in proportion to passenger-miles 86 per cent since 1923-25, and employee casualties in proportion to employee-hours, 84 per cent. The Duluth, Missabe & Iron Range, which received the silver medal for the best showing among those roads operating between one and ten million locomotive-miles, did not record a single casualty to passengers, trespassers or at grade crossings in 1938, and only two minor employee injuries were sustained on that road during the year. The Lake Superior & Ishpeming, which received the bronze medal for roads with less than one million locomotive-miles, has operated for seven consecutive years without an employee fatality; moreover, like the Duluth, Missabe & Iron Range, a passenger has never been killed.

I. C. C. Streamlines

Undoubtedly the Interstate Commerce Commission has been a bit jittery about the many criticisms that have been directed against it in the past few years. While the terms of the individual commissioners are long, still they must look forward to reappointment from time to time and occasionally they have been accused of being too politically minded and on keeping their ears too close to the ground. The hearings and debate on the railroad question in Congress during the first half of the year have sometimes reflected upon the Commission and its methods. Whatever the reasons may have been, the Commission announced during the early part of June that a number of changes in its internal organization would be effective July 1. It has been customary for many years for the chairmanship of the Commission to revolve among the different members on an annual basis. Chairman Marion M. Caskie, who was elected the first of this year, served only six months of his term, and effective July 1, Commissioner Joseph B. Eastman began a three-year term. The seven divisions were replaced by five and the individual commissioners are given more authority. The Motor Carrier Division has been criticized because of "motor-mindedness" and while it remains as Division 5, is stripped of authority with respect to rates and securities, and the approval of consolidations, mergers, purchases of motor carriers, formulation of accounts and enforcement of penalties. These matters will be functionalized under other divisions dealing with all carriers subject to the Act. The selection of Mr. Eastman for the three-year chairmanship was interpreted in some quarters as an attempt to put pressure on the promotion of co-ordinations and the elimination of alleged competitive wastes within the railroad industry. It is said, however, that the Commission had no such thought, but merely intended to improve its own internal set-up.

Rail Equipment Fund

Pump priming doesn't seem to have done much good throughout these long depression years, but in still another effort to have business lift itself by its bootstraps, President Roosevelt has suggested a plan over the next seven years for a $3,060,000,000 revolving fund for self-liquidating loans. It is planned to include $500,000,000 for railway equipment, to be acquired over a three-year period by the government agency, from which the carriers could lease the equipment with an option to buy. Apparently the Administration believes that the larger railroads have a surplus of freight cars which they are renting to the smaller roads at prohibitive rates. The smaller, poorer roads, it is claimed, are being forced to pay one dollar per car per day, when the cost of a freight car is only 55 cents a day. The assumption seems to be that the more fortunately located railroads are gouging the weaker ones. Those high in authority apparently overlook the fact that the railroads could readily finance the purchase of any equipment they might need if they could increase their net. Private capital would be only too glad to help them out on favorable terms. If conditions continue such that they cannot increase the net, then what is the use of adding to their equipment and taking another step toward bankruptcy, if indeed they are not already in that sad state?

Railroad Legislation

It was predicted that the railroad bill would be reported to the House before July 1, but the jam in Congress apparently caused it to be shelved for the time being. At any rate, nothing definite was known concerning it when this paper went to press. Whatever the committee may do in attempting to solve the railroad problem, will, without much doubt, be severely criticized by the various special interests that have shown little regard for the general public interest, but will fight to the limit to feather their own nests. Prompt and constructive action is essential.

Grade Crossing Accidents Last Year

The rail-highway grade crossing casualties decreased in 1938; they were in fact the smallest since 1933. There were 1,517 deaths and 4,018 injuries in 1938, compared to 1,875 deaths and 5,136 injuries in 1937, the latter year, by the way, having had the worst record since 1930. More than one-third of the accidents were caused by motor vehicles running into the sides of trains—35.29 per cent in 1938, as compared with 37.47 per cent in 1937. The 1938 casualties at grade crossings constituted 33.37 per cent of the fatalities and 25.92 per cent of the non-fatal injuries reported in connection with all of last year's railway accidents associated with train operation. A larger percentage of the 1938 crossing accidents occurred in daylight than in 1937—53.06 per cent, as compared with 51.47 per cent. Winter, as is to be expected, is the season of highest frequency and the hour of greatest frequency was between 5 and 6 p. m. in 1938; in 1937 it was between 7 and 8 p. m.

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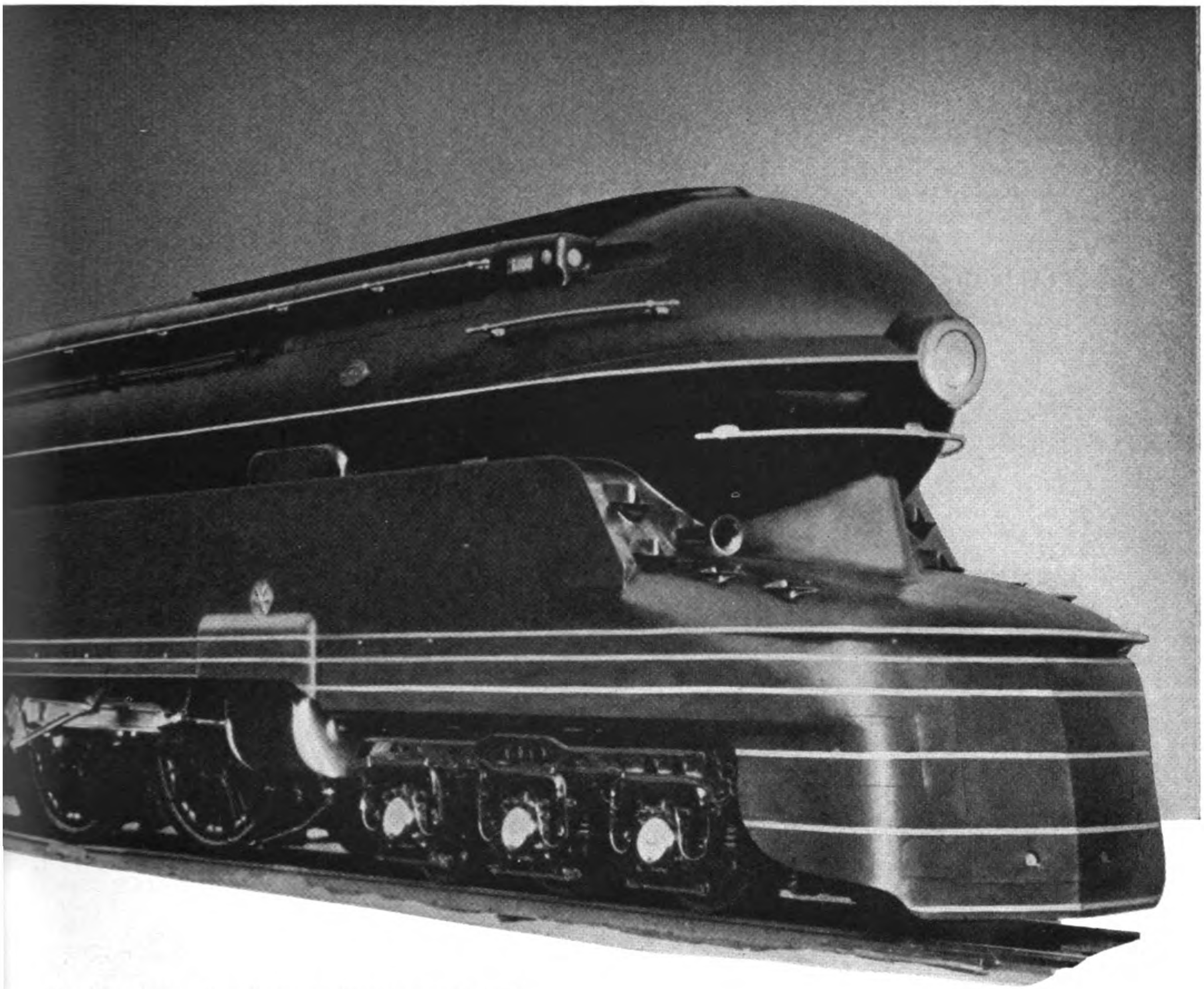
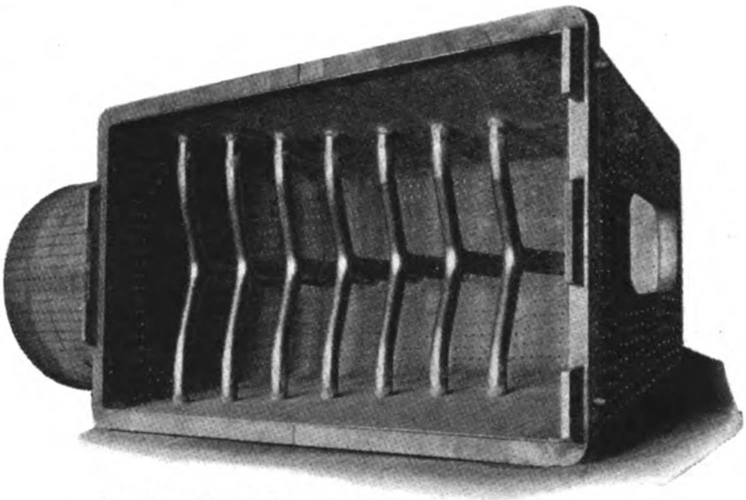


The Security Circulator makes it possible to support a properly proportioned arch in the 198″x96″ firebox of the American Railroads' 6-4-4-6 type locomotive. » » » While the Security Circulator was developed by the American Arch Company to keep pace with the demands for an improved brick arch support in large locomotives, it is equally adapted to all types and sizes of fireboxes. » » » In any locomotive firebox, irrespective of size, the Security Circulator will improve combustion and arch efficiency, reduce cinder cutting and flue stoppage, and improve the circulation in the side water legs.



Photograph of Security Circulators assembled in firebox.

COMPANY, INC.

New York ***Chicago***

NEWS

Equipment Building Programs

The Chicago, Milwaukee, St. Paul & Pacific has been authorized by the federal district court at Chicago to spend $327,373 for new equipment and to remodel present rolling stock. The C. M. St. P. & P. will spend $223,773 to construct 83, 50-ton all steel box cars and $103,600 to remodel 200 automobile cars in their own shops.

The Chicago, Rock Island & Pacific has undertaken a locomotive improvement program, for which $442,000 will be spent. Included are 20,000-gal. capacity tenders for 21 locomotives, to cost $202,000; and the enlargement of 12 tender tanks to 14,000-gal. at a cost of $26,000. Roller bearings and new engine trucks will be applied to 30 locomotives, at a cost of $147,000.

The Pennsylvania has authorized the construction of 25 21,000-gal. capacity locomotive tenders, to cost approximately $750,000. The tenders will be used in the operation of M-1 type locomotives in through freight service, and will permit the reassignment and redistribution of existing tenders of modern type among locomotives in main line through passenger service. They will supplement an equal number of tenders of similar capacity authorized last year.

Correction—World's Fair Exhibits

In the caption, in "Railroads on Parade" on page 223 of the June issue the New York Central Hudson type locomotive was incorrectly referred to as the "Commodore Vanderbilt." On page 229 the maximum drawbar horsepower of the same type locomotive should be 3,880 at 65 m. p. h. instead of 3,380.

Shop Additions

The Minneapolis, St. Paul & Sault Ste. Marie has awarded a contract amounting to approximately $35,000 to the Ernest M. Ganley Company, Minneapolis, Minn., for the construction of an addition to the machine shop and the rebuilding of a locomotive transfer table at the Shoreham shops of the Soo Line in Minneapolis.

The St. Louis Southwestern has awarded a contract amounting to approximately $35,000, to the Wisconsin Bridge and Iron Company, Chicago, for the construction of extensions to the machine shop and boiler shop at Pine Bluff, Ark.

A. S. M. E. Officers Nominated

Nominees for officers of the American Society of Mechanical Engineers for 1940 were announced at a recent meeting of the nominating committee held at State College, Pa. Nominees presented were: President—W. H. McBryde, consulting engineer, San Francisco, Cal.; vice-presidents—K. H. Condit, executive assistant to president, National Industrial Conference Board, New York; F. Hodgkinson, consulting mechanical engineer, New York; J. C. Hunsaker, head of department of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass.; K. M. Irwin, assistant to vice-president in charge of engineering, Philadelphia Electric Co., Philadelphia, Pa. Managers—J. W. Eshelman, president, Eshelman & Potter, Birmingham, Ala.; L. Helander, head of mechanical engineering department, Kanses State College, Manhattan, Kan.; G. T. Shoemaker, president, United Light & Power Service Co., Chicago.

A. A. R. High-Speed Truck Tests

The board of directors of the Association of American Railroads recently authorized the expenditure of $45,000 for the purpose of making road tests of various types of trucks in modern high-speed freight service. The initial tests were begun June 16 on the Pennsylvania, between Altoona, Pa., and Lock Haven. The test train consists of a Pennsylvania E-6 Atlantic-type steam locomotive with 80-in. driving wheels, and five cars, including two baggage cars and one coach, Nos. 1, 3 and 5, and two test cars, Nos. 2 and 4 in the train. The test cars have been leased, together with their instruments, from the Gould Coupler Corporation, and additional test instruments have been furnished by the A. A. R., and the Pennsylvania. The No. 3 baggage car serves as an office car for the accommodation of the test crew.

The objects of these tests, now being conducted by the A. A. R. Mechanical division, under the direction of W. I. Cantley, mechanical engineer, are to determine whether the conventional freight car truck has satisfactory riding qualities at speeds of 80 m.p.h., or more; also to determine the riding qualities and performance of various trucks designed specifically for the above high-speed service.

At a joint meeting of the various truck manufacturers on January 12, the program of tests was outlined and the following companies agreed to furnish trucks for test purposes, free of charge: Pennsylvania, Gould Coupler Corporation, National Malleable & Steel Castings, American Steel Foundries, Scullin Steel Company, Ohio Steel Foundry Company, Buckeye Steel Castings Company, the Bettendorf Company, Railway Truck Corporation, Standard Car Truck Company and Carry-Mussey Company.

A complete and extensive program of tests has been arranged, which will include road tests of each of these types of trucks under varying speed and load con-

(Continued on next left-hand page)

New Equipment Orders and Inquiries Announced Since the Closing of the June Issue

Locomotive Orders

Road	No. of Locos.	Type of Loco.	Builder
Atlantic Coast Line	2	2,000 hp. Diesel-electric[1]	Electro-Motive Corp.
C. R. I. & P.	1	Diesel-electric[2]	American Loco. Co.
Florida East Coast	2	2,000-hp. Diesel-electric[3]	Electro-Motive Corp.
Green Bay & Western	3	2-8-2[4]	American Loco. Co.
Kansas City Southern	1	1,000-hp. Diesel-electric	Electro-Motive Corp.
Phelps Dodge Corp.	1	600-hp. Diesel-electric	Electro-Motive Corp.

Locomotive Inquiries

Road	No. of Locos.	Type of Loco.	Builder
Boston & Maine	6	600-hp. Diesel-electric	....

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Aluminum Company of America	10	70-ton covered hopper	Pullman-Std. Car Mfg. Co.
Lehigh & New England	50	70-ton hopper[5]	American Car & Fdry. Co.
Missouri Illinois	125	Box[6]	Mt. Vernon Car Mfg. Co.
	25	50-ton gondola	Mt. Vernon Car Mfg. Co.
Republic Steel Corp.	4	50-ton air dump	Pressed Steel Car Co.
Western Maryland	500	50-ton box	Pressed Steel Car Co.
	500	50-ton hoppers	Bethlehem Steel Co.
	100	50-ton gondolas	Greenville Steel Car Co.
	10	50-ton flat	Greenville Steel Car Co.

Freight-Car Inquiries

Road	No. of Cars	Type of Car	Builder
Dow Chemical Co.	10	8,000-gal. tank	....
Erie	6	16,000-gal. aux. water tank	....
Tennessee Valley Authority	30	40-ton hopper	....

Passenger Car Orders

Road	No. of Cars	Type of Car	Builder
Atlantic Coast Line	14	See Note[1]	Edw. G. Budd Mfg. Co.
Florida East Coast	14	See Note[3]	Edw. G. Budd Mfg. Co.

Passenger Car Inquiries

Road	No. of Cars	Type of Car	Builder
Seaboard Air Line	..	See Note[7]	....

[1] The A. C. L. has ordered from the Edw. G. Budd Mfg. Co. two light weight trains of seven cars each to be hauled by the two Diesel-electric locomotives ordered from the Electro-Motive Corp. The trains will be operated between New York and Miami, Fla.

[2] This locomotive and the two ordered from the Electro-Motive Corporation as reported in the April issue, will be used on the Denver and other Rockets.

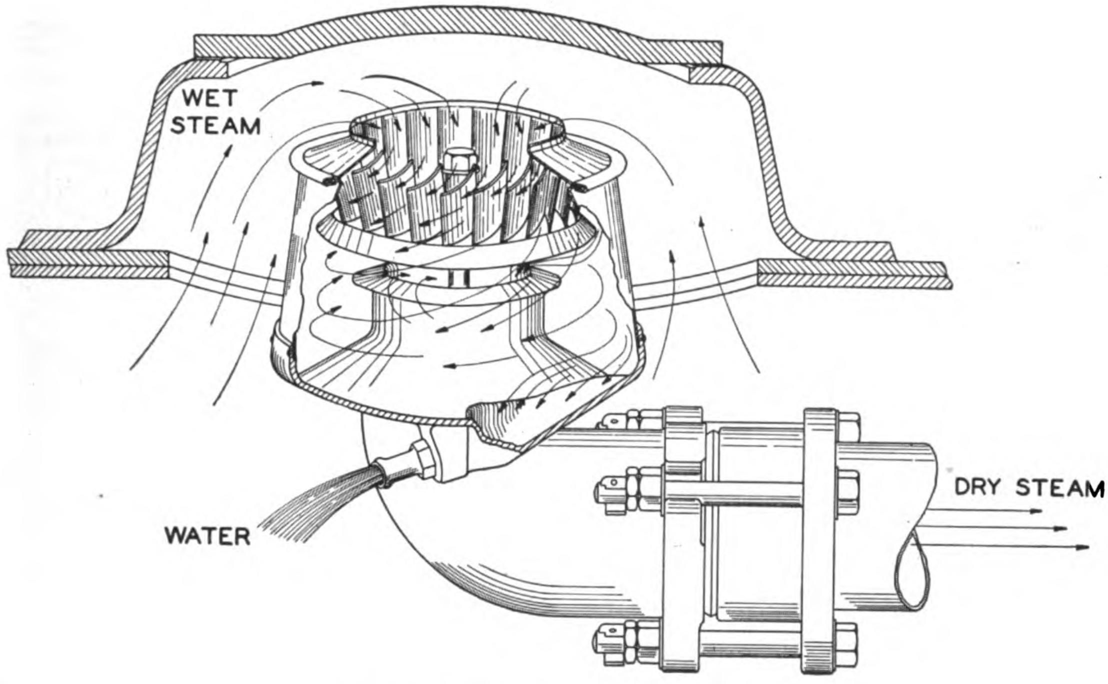
[3] The Florida East Coast, reported in the June issue, as planning to buy two new streamline trains of seven cars each, has ordered 14 lightweight, stainless steel cars for these trains from the Edward G. Budd Manufacturing Company. These trains, which will be hauled by the 2,000-hp. locomotives ordered from the Electro-Motive Corporation, will consist of a combination baggage and chair car, four chair cars, one dining car and one observation lounge car. They will be placed in service about December 1, between Jacksonville, Fla., and Miami.

[4] These locomotives will have 22-in. by 30-in. cylinders, 64-in. driving wheels, 245-lb. boiler pressure and a total weight of 285,000 lb. in working order.

[5] Special type, hatchway-roof, hopper-bottom steel cars to be used for bulk cement lading.

[6] These in addition to the 150 cars for this road reported in the Missouri Pacific order in the May issue.

[7] Inquiring for one or two lightweight coach trains of seven cars each.



TESTS

of an Elesco Tangential Steam Dryer

The Elesco tangential steam dryer has been tested on modern locomotives and its ability to handle large quantities of moisture was conclusively demonstrated by spraying water into the dryer, in quantities up to 20 per cent of the water evaporated by the boiler. Water sprayed into the dome was accurately measured with a flowmeter and the drop of superheat was read on the pyrometer.

The results obtained are shown in the accompanying table. Attention is called to test run No. 2, when 6756 lb. of water were sprayed into the dome, equivalent to 16.4 per cent moisture, and resulting in only a 36 degree drop in superheat. Had it not been for the dryer, there would have been a 244 degree drop in superheat.

Run Number	Steam Flow Thru Dry Pipe	Water Sprayed into Dryer		Actual Drop in Superheat °F	Calculated Drop in Superheat if Sprayed Water Had Not Been Separated °F	Moisture in Dry Pipe		Moisture Returned to Boiler Lb./Hr.	Dryer Efficiency Per Cent
	Lb./Hr.	Lb./Hr.	Per Cent			Per Cent	Lb./Hr.		
1	2	3	4	5	6	7	8	9	10
1	34562	1999	5.5	11	87	0.6	212	1787	89.5
2	35073	6756	16.4	36	244	2.1	723	6033	89.1

ELESCO

A-1330

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ditions, also with round—and eccentric-ground car wheels. The test procedure has been worked out in great detail so as to develop accurate comparative data on a strictly impartial basis, with minimum delay and cost in changing trucks, varying car loads, etc. It is anticipated that the tests will be completed late this Fall.

"Royal Train" Locomotives Now at N. Y. World's Fair

The Canadian locomotives — Canadian National No. 6400 and Canadian Pacific No. 2850—which hauled the royal train during the recent visit of King George and Queen Elizabeth in the Dominion, are now on exhibit at the railroad area at the New York World's Fair.

C. N. R. No. 6400, which is said to be the largest locomotive in the British Empire, is 94 ft. long with tender and weighs in excess of 650,000 lb. It left Montreal, Que., on June 16 and traveled under its own steam over the Central Vermont to Springfield, Mass., where, owing to weight limitations and clearance conditions, its tender was emptied of water and coal and the locomotive deadheaded the remainder of the distance to the fair.

C. P. R. No. 2850 was one of 20 of the same series constructed in 1929 and 1930. For the purpose of hauling the royal train it was redecorated with a semi-streamline front bearing the royal arms over the headlight. After a check-up at the Angus shops, the 2850 hauled its regular train to Toronto, Ont. From there it ran light over the Toronto, Hamilton & Buffalo to Welland, Ont., Michigan Central to Suspension Bridge, N. Y., New York Central main line to Rochester, N. Y., West Shore and Boston & Albany to Chatham, N. Y., Harlem division of the New York Central to New York, New York, New Haven & Hartford over Hell Gate bridge and Long Island to the fair grounds. Both locomotives which are finished in royal blue and silver, will appear in the final scenes of the opera-pageant "Railroads on Parade."

Chilled Car Wheel Association's Work Commended

The American Trade Association Executives have this year sponsored their seventh annual competition for outstanding trade association activities. Over 20 associations competed, submitting individual manuscripts and supporting documents covering both general activities and special achievements. The only association to receive recognition for work of specific interest and value in the steam railroad field was the Association of Manufacturers of Chilled Car Wheels, which received one of eight honorable mention prizes.

The prizes were presented on behalf of the American Trade Association Executives, by Edward J. Noble, executive assistant to the United States secretary of commerce, at a meeting in Washington, D. C., last month, and, in the absence of President Frank Hardin of the Association of Manufacturers of Chilled Car Wheels, Past President D. H. Sherwood, vice-president, Maryland Car Wheel Company, Baltimore, Md., accepted the award.

The citation read as follows: "The Association of Manufacturers of Chilled Car Wheels—for its achievement in obtaining complete co-operation of its industry in a program of quality standardization. This was brought about through an effective industrial research program, followed by arrangements for a field staff of technical inspectors which periodically visits all railroad car-wheel factories, the receipt of daily reports on processes and specifications and special training for employees. The quality of product has been improved. Production expenses have lessened. Greater appreciation of mutual engineering and selling problems has been a natural and desirable result."

D. L. & W. Buffet-Lounge Car

The Delaware, Lackawanna & Western has turned out a buffet-lounge car in its Kingsland (N. J.) shops, the interior decoration of which utilizes, for the first time in railroading, color photography on stainless steel. A new secret process whereby the subject is photographed directly on stainless steel by chemical-light action has been developed by Permanent Arts, Inc., New York, and the Electro-Metallurgical Company, a subsidiary of United States Steel Corporation. For the Lackawanna car six photographs of early locomotives of the road ("Spitfire," "Essex," "Speedwell," "No. 16," "John R. Blair," and the "A. Lincoln") have been so reproduced and the steel plates imbedded in plate glass mirrors, left partially unsilvered to permit the photographs to be viewed. These mirrors appear in panels at the ends of the buffet-lounge section.

The car is fully air-conditioned by a Safety-Carrier ice-activated system with evaporator unit and Pyle-National multi-vent outlets. The kitchen is air-conditioned partly by a branch outlet and partly by exhaust air from the main part of the car. Interior illumination of the car, of 10 foot candle intensity, consists of a sky-light type center row of 90 15-watt lamps with a white plastic cover; safety, double-prismatic direct reading lights over each seat with 25-watt lamps and four small table lamps.

The car is a rebuilt standard steel parlor car designed by Douglas Ernst of Contract Service, Inc., New York.

Supply Trade Notes

The Bird-Archer Company has moved its Chicago office from 122 South Michigan avenue to 2030 North Natchez avenue.

◆

G. Fred Driemeyer, sales engineer for the General Steel Castings Corporation, has been promoted to assistant works manager at Granite City, Ill.

◆

William H. Harman and William H. Winterrowd, vice-presidents in charge of sales and operations, respectively, of the Baldwin Locomotive Works, have been elected to the board of directors of the company.

◆

The American Engineering Company, Philadelphia, Pa., has purchased the Diamond Machine Company, Providence, R. I., and will continue the manufacture of the Diamond face grinder in its Philadelphia plants.

◆

Joseph T. Ryerson & Son, Inc., Chicago, has purchased the Philadelphia plant of the Taylor-Wharton Iron & Steel Company, which Ryerson has been operating under lease.

◆

Parker F. Wilson has been appointed president of the Pittsburgh Steel Foundry Corporation, Glassport, Pa., and G. A. Hassel, the company's former president, will continue as chairman of the board of directors.

◆

J. G. Coutant has been appointed vice-president of Controlled Steam Generators, Inc., New York, in charge of engineering work in connection with the design and construction of steam generators and metallic heat recuperators with controlled-pressure circulations.

◆

The Carboloy Company, Inc., has opened a new plant and general offices at Detroit, Mich., this new plant for the manufacture of cemented carbide products, embraces a total area of 121,750 sq. ft. and combines all manufacturing facilities formerly divided among Carboloy plants in Cleveland, Ohio, Detroit, and Stamford, Conn.

◆

L. C. Ricketts, recently appointed general superintendent of the Harrison, N. J., works of the Worthington Pump & Machinery Corporation, has been appointed manager of that works. W. D. Sizer has been appointed executive engineer in charge of all engineering activities at Harrison, and B. R. McBath, has been appointed engineer in charge of the centrifugal engineering division, succeeding Mr. Sizer.

◆

J. Frederic Wiese who has been appointed general manager of sales of the Lukens Steel Company, Coatesville, Pa., was born at Parkesburg, Pa., in January, 1899, and educated in the Parkesburg

schools and Swarthmore College, from which he was graduated in 1921, with the degree of bachelor of arts. Mr. Wiese then joined the Chicago sales office of the Parkesburg Iron Company and was en-

J. Frederic Wiese

gaged in the sale of boiler tubes to the railroads until the latter part of 1924, at which time he was transferred to the home office. The following year he became associated with the Lukens Steel Company, where he has served continuously in its flanging, railroad and general sales departments, with the exception of a period of one year in 1928. In 1935, he was appointed assistant to vice-president in charge of sales, which position he held at the time of his recent promotion to general manager of sales.

◆

Albert C. Pickett of the Gustin-Bacon Manufacturing Company, Kansas City, Mo., has been transferred to Chicago as manager of the Insulation division, Chicago district. Mr. Pickett was born at Waco, Texas, on October 5, 1897, and completed high school and business college courses at that place. He served on the Missouri-Kansas-Texas and the Texas & Pacific in stenographic and clerical capacities in the mechanical stores, engineering and transportation departments, with the exception of a period during the World War when he was with the field artillery, United States Army, until 1922, when he became associated with the railroad department of the Johns-Manville Company, at St. Louis, Mo. In 1925 he was transferred to Houston, Texas, as sales engineer, where he was located until 1929, when he was promoted to assistant sales manager, transportation department, southwestern division, with headquarters at St. Louis. In 1933, he was appointed sales

Albert C. Pickett

manager, in which capacity he served until his resignation on May 1 to enter the service of the Gustin-Bacon Manufacturing Company.

Personal Mention

General

Edward E. Root, whose appointment as assistant chief of motive power of the Delaware, Lackawanna & Western at Scranton, Pa., was announced in the June issue, was born at Altoona, Pa., and edu-

Edward E. Root

cated in the public and high schools of that city. He entered railroad service in September, 1902, as a machinist apprentice in the Altoona works of the Pennsylvania, following which he completed the four-years' course of mechanical instruction, road, operation and testing of equipment. In December, 1906, Mr. Root was assigned to special duty in the mechanical, maintenance and operating departments. He was appointed motive-power inspector in December, 1907, on the staffs of the master mechanic and superintendent of motive power. In December, 1908, Mr. Root became enginehouse foreman of the Monongahela division and general foreman of engine operations at Monongahela City, Pa. In September, 1913, he was appointed master mechanic and superintendent of motive power of the Monongahela at Brownsville, Pa. Mr. Root resigned in April, 1920, to engage in business at Pittsburgh, Pa. In December, 1923, he re-entered railroad service with the Delaware, Lackawanna & Western on the Morris and Essex division of which he was serving as master mechanic, with headquarters at Hoboken, N. J., at the time of his recent appointment.

H. C. Wyatt has been appointed superintendent of the Shenandoah division of the Norfolk & Western at Roanoke, Va., as announced in the June issue of the *Railway Mechanical Engineer*. After working for the Norfolk & Western during school vacation periods, Mr. Wyatt was appointed special apprentice in the Roanoke shops in June, 1924. Since that

H. C. Wyatt

time he served successively as shop inspector at Roanoke and Bluefield, W. Va.; special apprentice at Portsmouth, Ohio; assistant foreman and foreman at Iaeger, W. Va.; assistant road foreman of engines, Pocahontas division, and general foreman at Columbus, Ohio. He was appointed assistant master mechanic of the Radford-Shenandoah divisions on August 1, 1937, the position he held until his appointment as division superintendent.

Otto Jabelmann, assistant to the president in charge of research, of the Union Pacific, at Omaha, Neb., has been elected

Otto Jabelmann

to fill the newly-created position of vice-president in charge of research and mechanical standards, with the same headquarters. Mr. Jabelmann was born at Cheyenne, Wyo., on July 24, 1890, and entered railway service as a call boy for the

(*Continued on second left-hand page*)


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Union Pacific on September 22, 1906. He has been continuously in the service of the Union Pacific since that time with the exception of three years, during which time he attended the University of Michigan and a period from May to August, 1917, when he was employed as a machinist on the Southern Pacific at San Francisco, Calif. Mr. Jabelmann advanced through the mechanical department, serving successively as apprentice, machinist helper, machinist and assistant enginehouse foreman at Cheyenne, general foreman at Laramie, Wyo., machinist at North Platte, Neb., and enginehouse foreman, district foreman, and superintendent of shops at Cheyenne. On January 1, 1929, he was transferred to Omaha as superintendent of shops; in October, 1933, was appointed general superintendent of motive power and machinery at Omaha, and in November, 1937, became assistant to the president in charge of research. Mr. Jabelmann has been in charge of the designing of the new steam-electric locomotive recently delivered to the Union Pacific; the new Diesel-electric locomotives on the City of Los Angeles, the City of San Francisco, and the City of Denver; the new truck improvements used on lightweight freight cars, and new lighting and air-conditioning equipment.

John Gogerty, general superintendent of motive power and machinery of the Union Pacific at Pocatello, Idaho, has been transferred to the Eastern district, with headquarters at Omaha, Neb.

O. G. Pierson, master mechanic of the Atchison, Topeka & Santa Fe at Arkansas City, Kan., has been appointed mechanical superintendent, with headquarters at Fort Madison, Iowa, succeeding J. P. Morris.

Logan A. Hamilton, locomotive engineer of the Union Pacific, has been appointed acting fuel engineer of the Eastern district, with headquarters at Omaha, Neb., succeeding O. K. Woods, who has been given a leave of absence.

J. P. Morris, mechanical superintendent of the Atchison, Topeka & Santa Fe, with headquarters at Fort Madison, Iowa, has been promoted to general assistant mechanical department, with headquarters at Chicago.

S. C. Smith, master mechanic of the Union Pacific at Pocatello, Idaho, has been appointed assistant general superintendent of motive power and machinery of the Western districts, with the same headquarters.

W. R. Harrison, superintendent of shops of the Atchison, Topeka & Santa Fe at Albuquerque, N. M., has become mechanical superintendent, at Amarillo, Tex. Mr. Harrison began railway service as a machinist apprentice on the Southern at Princeton, Ind., and on April 1, 1912, he joined the Santa Fe as a machinist at Richmond, Cal., and was transferred to Topeka, Kan., a short time later. In November, 1912, he was promoted to night enginehouse foreman at Argentine, Kan., and in 1914, was advanced to general foreman at Newton, Kan. Mr. Harrison was promoted to master mechanic at Chanute, Kan., in November, 1917, and served as master mechanic or acting master mechanic at Argentine and Chanute until February 1, 1934. On the latter date he became superintendent of shops at Albuquerque, the position he held until his recent promotion to mechanical superintendent.

E. E. Machovec, mechanical superintendent of the Atchison, Topeka & Santa Fe at Amarillo, Tex., retired on June 1. Mr. Machovec was born on March 26, 1866, and entered railway service in 1885, as a machinist apprentice on the Chicago, St. Paul, Minneapolis & Omaha. In 1904, he entered the service of the Denver & Rio Grande Western at Helper, Utah, and the following year he became associated with the Santa Fe as enginehouse foreman at Newton, Kan. In 1908, he became general foreman at that point and in the fall of that year was advanced to master mechanic at Newton. Mr. Machovec was transferred to Argentine, Kan., in 1911, and from November, 1921, to March, 1922, served as acting mechanical superintendent of the Northern district, Western lines, with headquarters at La Junta, Colo. In September, 1922, he was appointed mechanical superintendent of the Southern district, with headquarters at Amarillo.

Master Mechanics and Road Foremen

Frederick T. James, who has been appointed to the position of division master mechanic of the Delaware, Lackawanna & Western at Hoboken, N. J., as noted in the June issue, was born at Buffalo, N. Y., on March 16, 1894. He worked at various

F. T. James

occupations while attending grammar school and the first year of high school, and became a machinist apprentice at Farrar & Trafts Machine & Boiler Works, Buffalo, in July, 1908. His later educational training has included courses in civil service and government at Bryant & Stratton Business College, Buffalo and machineshop practices and automobile mechanics at the Buffalo Y. M. C. A. He has acted as chairman of foremanship courses at Hoboken, N. J., under the New Jersey State Vocational Education Department, and has taken lectures and discussions in shop employee psychology at the State Normal School at Montclair, N. J. He also took a special electrical course at the Paterson, N. J., Vocational School prior to the electrification of the metropolitan section of the Lackawanna. In September, 1909, he became an enginehouse utility worker at East Buffalo, on the Lackawanna. For some months in 1911, he was assigned to the master mechanic's office in connection with the compilation of special locomotive performance reports, later being promoted to coal chute foreman at East Buffalo enginehouse, and then acting as a machinist at the East Buffalo locomotive shop. He became general foreman at Groveland, N. Y., in October, 1915, and erecting shop foreman at East Buffalo in February, 1918. He then filled various positions until in February, 1923, he was assigned to the Buffalo division as special locomotive and boiler inspector. On November 1, 1923, he was transferred to Binghamton as day enginehouse foreman, and on February 18, 1924, was promoted to general foreman at the Kingsland, N. J., locomotive shop. Mr. James was secretary of the Lackawanna Foremen's Association at East Buffalo from 1918 to 1922, and was First Lieutenant, Engineers, 491st Division, Reserve Officers, from 1925 to 1935. He then served as a member of the sub-committee on Consolidation of Major Shops, Regional Coordinating Committee, Eastern Railway Group. He was elected president of the International Railway General Foremen's Association in September, 1936, and secretary-treasurer of the same association in September, 1937.

R. E. Wees, superintendent of shops of the Union Pacific at Cheyenne, Wyo., has been appointed master mechanic at Pocatello, Idaho, replacing S. C. Smith.

R. B. Miller has been appointed master mechanic, Kamloops division, British Columbia district, of the Canadian National, with headquarters at Jasper, Alta.

P. J. Danneberg, master mechanic of the Atchison, Topeka & Santa Fe at Slaton, N. M., has been transferred to Clovis, N. M., succeeding G. R. Miller.

L. E. Fletcher, master mechanic of the Atchison, Topeka & Santa Fe at La Junta, Colo., has been transferred to Slaton, N. M., succeeding P. J. Danneberg.

James W. Atkinson, general locomotive foreman of the Atchison, Topeka & Santa Fe at Argentine, Kan., has become master mechanic at Arkansas City, Kan.

G. C. Hess, assistant road foreman of engines of the Maryland division of the Pennsylvania, has been appointed acting road foreman of engines of the New York division.

Ray E. Murphy has been appointed road foreman of engines of the Yellowstone division of the Northern Pacific with headquarters at Dickinson, N. D.

Patrick W. Hannon, road foreman of engines of the Northern Pacific at Dickinson, N. D., has been appointed road foreman of engines at Auburn, Wash.

(Turn to next left-hand page)

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Car Department

A. C. Schroeder, general foreman of the freight shop of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., has been promoted to the position of general car department supervisor at Minneapolis, Minn.

F. J. Swanson, general car department supervisor of the Chicago, Milwaukee, St. Paul & Pacific at Minneapolis, Minn., has been appointed general foreman in the freight department of the Milwaukee shops at Milwaukee, Wis.

Shop and Enginehouse

G. R. Miller, master mechanic of the Atchison, Topeka & Santa Fe, at Clovis, N. M., has been appointed superintendent of shops at Albuquerque, N. M., succeeding W. R. Harrison.

C. F. Spicka, who has been acting assistant general superintendent of motive power and machinery of the Eastern district of the Union Pacific at Omaha, Neb., has returned to his former position as superintendent of shops at Cheyenne, Wyo.

Obituary

E. A. Schrank, master mechanic of the Chicago, Burlington & Quincy, with headquarters at Casper, Wyo., died on June 22 following an operation.

Calvin C. Hipkins, road foreman of engines of the New York zone of the Pennsylvania with headquarters at Jersey City, N. J., died on June 12 at his home in Union, N. J., following a heart attack. He was 57 years old.

Burt J. Farr, general superintendent of motive power and car equipment of the Grand Trunk Western, at Battle Creek, Mich, died on June 10, after an extended illness. Mr. Farr was born at Ellenburg, N. Y., on September 18, 1876, and entered railway service in 1893 as a machinist apprentice on the Central Vermont. In 1898, he was promoted to machinist and two years later was advanced to the position of general foreman. In 1907, he went with the Northern Railway of Costa Rica as master mechanic and in 1910, he became

Burt J. Farr

associated with the Panama Railroad, serving in the engineering department. On January 1, 1915, after his return to this country, Mr. Farr was appointed general foreman on the Grand Trunk Western at Nichols, Mich., and a few months later became locomotive foreman. He was appointed master mechanic on October 1, 1916, and two years later became superintendent of motive power and car building at Detroit, Mich. On January 1, 1928, he was appointed general superintendent of motive power and car equipment at Battle Creek.

James W. King, vice-president of the Association of American Railroads in charge of its Operations and Maintenance Department, was found dead on June 12 along the Richmond, Fredericksburg & Potomac tracks about 20 miles north of Richmond, Va. According to information received at the A. A. R., he became weak from illness, and fell off the rear platform of the train on which he was traveling to his home in Richmond. Mr. King, who joined the A. A. R. last January as successor to J. M. Symes, was born on February 13, 1890, in Sussex County, Va. After completing school in Sussex County, he attended Smithfield Business College, Richmond. He served in various clerical and secretarial positions on the Chesapeake & Ohio and the Atlantic Coast Line, later rising successively to chief special agent and freight-claim agent for the former road. He served as a member of the Executive Committee, Freight Claim

James W. King

division, American Railway Association; as chairman of an Arbitration Committee, and was chairman of the Chicago, Virginia and Southeastern Claim Conferences, respectively. Mr. King, until his election to the Association of American Railroads last January, was general superintendent of transportation of the Chesapeake & Ohio, to which position he succeeded on April 18, 1933. In 1934 Mr. King was appointed by the Co-ordinator of Transportation to membership on the Committee on Freight Car Pooling.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Eyeshields. — The Jackson Electrode Holder Co., 15122 Mack avenue, Detroit, Mich. Folder on eyeshields for general eye protection in hazardous occupations.

◆

Jacks.—The Buda Company, Harvey, Ill. Eight-page bulletin. Illustrates and describes Buda line of jacks for railroad service.

◆

Ferrous Castings.—Belle City Malleable Iron Co. and Racine Steel Castings Co., Racine, Wis. Four-page bulletin descriptive of four types of ferrous castings—steel, malleable, pearlitic malleable, and electric gray iron.

◆

Taper Die Heads.—The Geometric Tool Company, New Haven, Conn. Bulletin CT-1, Geometric Style CT taper die heads for use in hand screw machines, turrent lathes, and other similar equipment.

◆

Eye Protection.—Mine Safety Appliances Company, Braddock, Thomas and Meade streets, Pittsburgh, Pa. Eight-page bulletin No. CE-8, illustrating goggles and spectacles, welding helments and shields, etc.

◆

Boilfr Shop Machinery. — Jos. T. Ryerson & Son, Inc., Lock Box 8000-A, Chicago. Portfolio of information on Ryerson flue shop equipment, together with floor plans and a detailed explanation of the method of handling tube repairs in the boiler shop.

"Industrial Head and Eye Protection." — Chicago Eye Shield Company, 2300 Warren Boulevard, Chicago. 48-page illustrated book on goggles, respirators, spectacles, masks, welding helmets and other safety devices.

◆

Die Heads.—Landis Machine Company, Inc., Waynesboro, Pa. Bulletin No. 5-90. Landmatic, Lanco, and Landex heat-treated die heads for turret lathes, bolt-threading machines, and automatic screw machines, respectively.

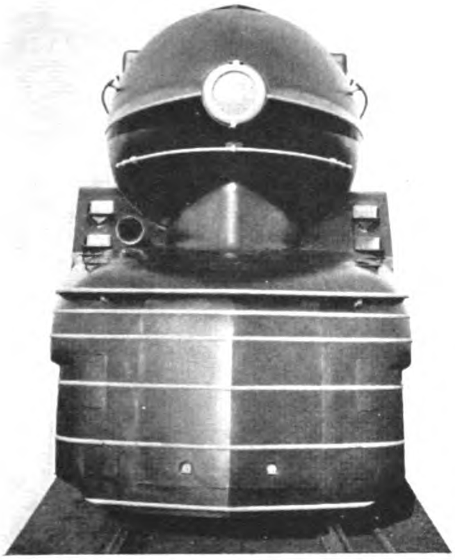
◆

Bearing Bronze.—Johnson Bronze Company, New Castle, Pa. Catalogue 390; 72 pages. Progressive size listings of Johnson general purpose bearings in 800 stock sizes, machine finished ready for assembly. Special sections on oil grooving, flanged bearings and bushings, and a decimal equivalent chart.

RAILWAY MECHANICAL ENGINEER

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office.



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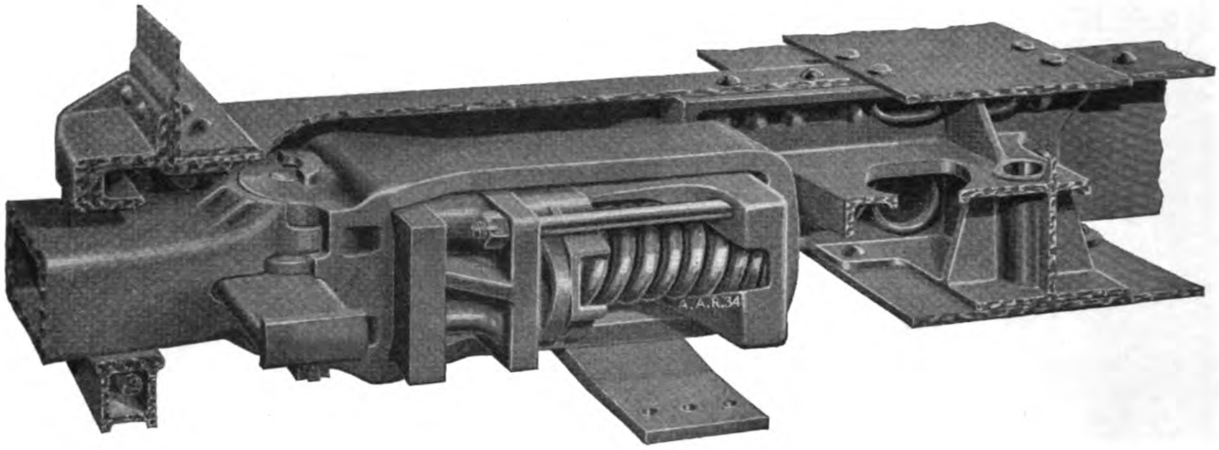
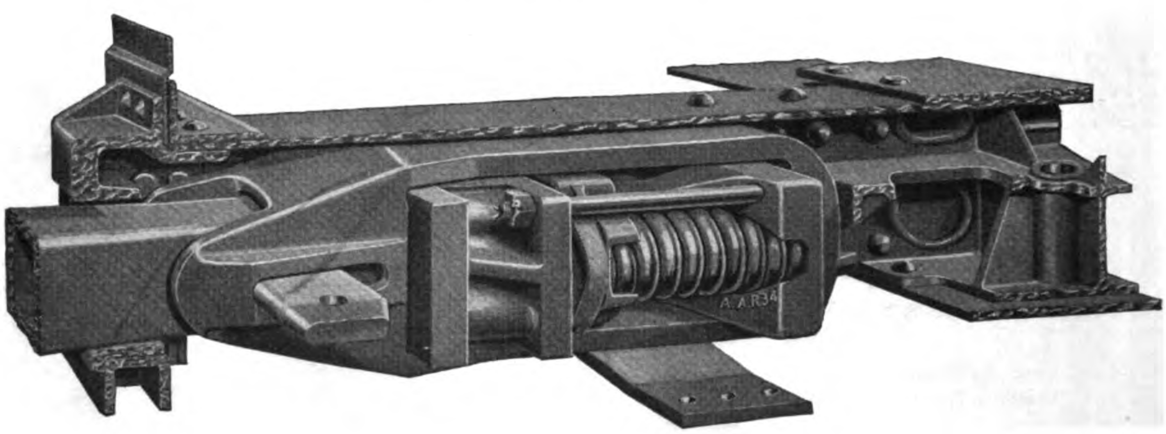
August, 1939

Volume 113 *No. 8*

Ideal, Compact Applications



A. A. R. Certified M-17-A. Draft Gear
A. A. R. Alternate Standard "E" Coupler
with Swivel Shank
A. A. R. Alternate Standard Swiveling
Cast Steel Yoke



A. A. R. Certified M-17-A. Draft Gear
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RAILWAY MECHANICAL ENGINEER

An Investigation of

Railway Wheel Tread Contours*

By F. H. Smith†

Adopted tread standards are compromises and not based on scientific research—A study of tread contour design—The author proposes a simple design with cylindrical tread

During the first 40 years of existence of the American railroad industry, most of the technical progress and development was on an individualistic basis and represented the ideas of men who were not specialists. As the industry grew into a complete continental transportation system, the transfer of passengers and freight from one carrier to another, the need for intercompany arrangements in making timetables, the interchange of equipment, and government regulation made it perhaps the most co-operative industry in existence. The success of any one road was not dependent entirely on its own local traffic, but to a very great extent on the business coming from other connecting lines.

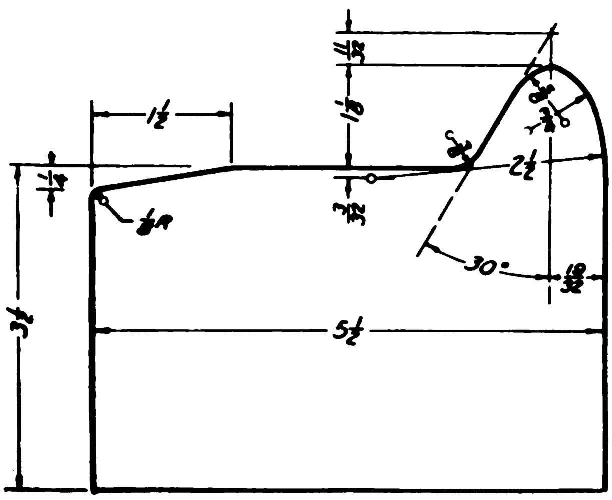


Fig. 1—Tread contour proposed, but not adopted, A. R. M. M. A., 1886

As a means of facilitating the exchange of information of mutual interest, associations were organized by railroad officials in various departments. The organization of the Master Car Builders' Association in 1867 and of the American Railway Master Mechanics Association in 1868, marked the official beginning of mechanical co-operation. One of the first and most important duties of these associations was, of course, to standardize mechanical details in order to promote economy and make equipment interchange feasible.

Tread Contour Standardization

The first indications of an attempt to standardize tread contours came in the early 1880's. At the annual convention of the A. R. M. M. A. in 1883, there was an extensive discussion on the subject of wheel treads, with particular attention given to the desirability, or undesirability, of coning or tapering the tread. At that time many held the popular belief that the tapered tread was beneficial on curves in compensating for the distance traveled around the outer rail being greater than that of the inner rail. Although this theory was considered by some railroad officers as an important factor as late as 1912, it is accepted today only by the layman who finds it as an oddity in popular reading matter. In other countries where cars are constructed with axles which assume the radial position on curves there is some advantage in coning, but the amount is questionable.

In 1884 the A. R. M. M. A. sent a questionnaire to the members asking whether they used tapered treads or straight treads and for their opinions and recommendations concerning these two designs. Twenty-eight replies were received with widely different answers and drawings submitted with the replies indicated a wide variation in the design of tread contours in service at that time. A committee was appointed to propose a standard tread, which they presented in 1886. This proposed tread, shown in Fig. 1, did not meet with sufficient approval for adoption and a decision was made to delay further action until after the M. C. B. agreed upon a standard.

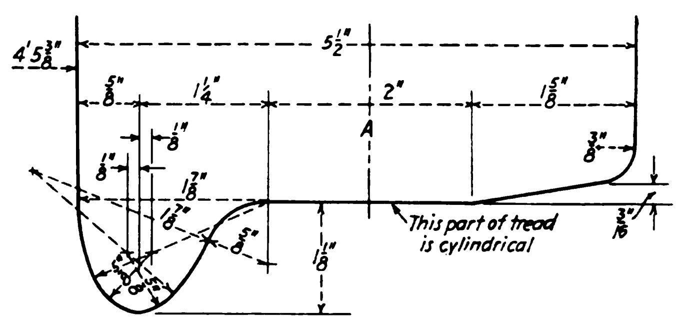


Fig. 2—Tread contour proposed in 1885 by the M. C. B.—Not adopted

At the annual convention of the M. C. B. in 1885, a

* Abstract of a thesis entitled, "An Investigation of the Design of Railway Wheel Contours" submitted to the faculty of Purdue University.
† Assistant professor of mechanism and engineering drawing at the University of Michigan.

good portion of the meeting was devoted to the subject of tread contours, with discussions on taper, throat radius, cause of sharp flanges, and cooperation with the maintenance-of-way department in fitting the tread contour to the standard rail sections. A committee proposed a standard contour, Fig. 2, which was submitted for letter ballot but failed to be adopted. In the following year, after two letter ballots had failed to adopt a standard, members were urged by the chairman to state, at the convention, their reasons for voting against the previously proposed standards. The letter ballot which followed resulted in the adoption of the first standard contour, Fig. 3. In 1887 this same tread was adopted as

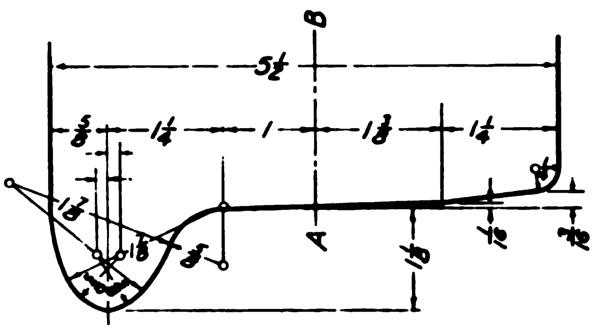


Fig. 3—Tread contour adopted in 1886 by the M. C. B., and in 1887 by the A. R. M. M. A.

standard by the A. R. M. M. A. In 1893, the A. R. M. M. A. standardized all tires with a design having the same basic contour as that previously adopted.

The next change came in 1906 when a new standard, Fig. 4, was adopted by the M. C. B. with a taper of 1 in 20 and with the throat radius increased to $1\frac{1}{16}$ in. The previous standard had a taper of 1 in 38. The

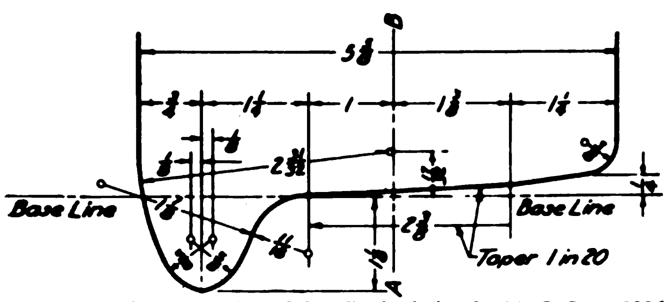


Fig. 4—Tread contour adopted for all wheels by the M. C. B. in 1906

A. R. M. M. A. followed by changing the taper to 1 in 20 but retained the old throat radius of ⅝ in.

At the 1909 meeting of the M. C. B., a representative of the wheel industries recommended increasing the throat radius as a means of minimizing sharp flanges. The effect of moving the center of the throat radius was mentioned as a possible cause of derailment of switching locomotives. New standard treads were adopted for both steel and cast-iron wheels, shown in Figs. 5 and 6, respectively.

Wheel treads were a point of interest in the A. R. M. M. A. again in 1912, when a recommendation was made, and later accepted, to reduce the widths of all tires to 5½ in. There was a lengthy discussion on the desirable height of flanges on locomotives. The values in question were ⅞ in. and 1 in. for switching, and 1 in. and 1⅛ in. for road-service locomotives. At this time many expressed a preference for cylindrical treads. Another topic discussed was the desired width of worn flanges for re-turning steel wheels. Adoption of the M. C. B. standard was recommended for tender and engine-truck wheels. In 1913, a reduction in taper was suggested as a means of reducing rail stresses which were causing difficulties for the maintenance-of-way departments. The desirability of thicker flanges on cast-iron wheels was pointed out and a check was made to see if the clearances at frogs and crossings would permit such an increase. In 1914, a new tread, Fig. 7, was adopted for steel and steel-tired wheels on engine and tender trucks, and on driving wheels in switching service.

In 1920, the American Railway Engineering Association reported to the Mechanical Division of the A. R. A., stating that frogs and crossings had sufficient clearances to pass the thicker flanges which had previously been proposed for cast-iron wheels. The Wheel Committee of the Mechanical Division met in 1923 with the A. R. E. A. in order that each might be familiar with any contemplated changes to be made by the other relative to rail sections or tread contours. The maintenance-of-way group stated at this time, that spreading rails and excessive wearing into ties and tie plates, caused by tapered treads, had been overcome by canting the rails. In this

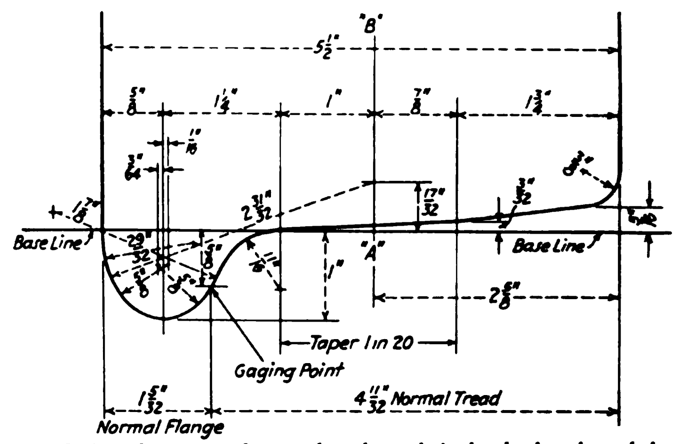


Fig. 5—Tread contour for steel and steel-tired wheels adopted by the M. C. B. in 1909

same year lengthening the 1 in 20 taper was considered in order to increase the bearing area between the wheel and rail.

In 1925, tests were started on steel-wheel tread wear, and a questionnaire was issued to determine the feasibility of using the same tread for all steel and steel-tired wheels, including driving wheels. Results of tests were

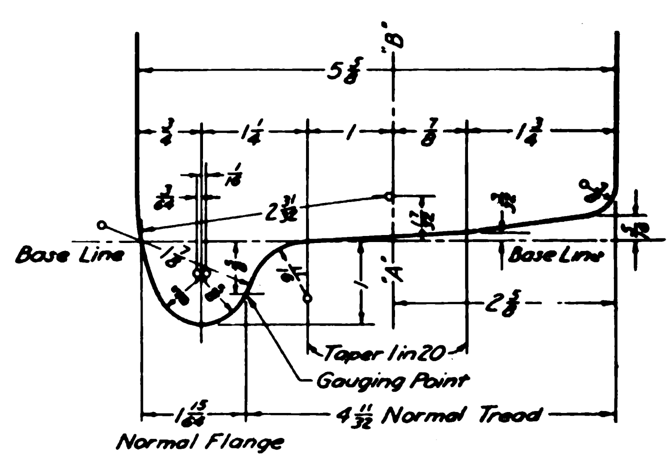


Fig. 6—Cast-iron wheel-tread contour adopted by the M. C. B. in 1909

presented in 1926, showing the comparison of wear on A. R. A. standard contours and treads with tapers of 1 in 38 and 1 in 13. No significant difference was noted

in tread wear but the flange wear was less on the wheels with the most taper as indicated in Fig. 8. Further test reports in 1927 showed that the shape of the tread had little to do with tread wear. Opinions regarding taper were voiced again in 1928 when the 1 in 13 taper was

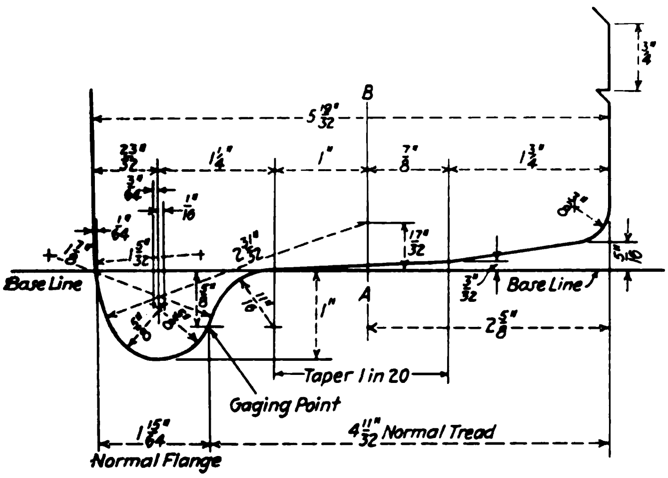


Fig. 7—Tread contour adopted by the A. R. M. M. A. in 1914

strongly favored by some, because this taper kept the flanges away from the rails. A new tread for cast-iron wheels, Fig. 9, was adopted that year.

The Locomotive Construction Committee agreed with the Wheel Committee in 1931, to use the same tread on all steel and steel-tired wheels. This decision eliminated the 1⅛-inch flanges on driving wheels. In 1932, a single straight taper was proposed to replace the double taper, but it was agreed to retain the double taper on cast-iron wheels because of a desirable relation with brake shoes. New treads were adopted in 1936, Figs. 11 and 12.

The preceding historical information was taken entirely from the proceedings of the different railway mechanical associations, and certainly does not represent all

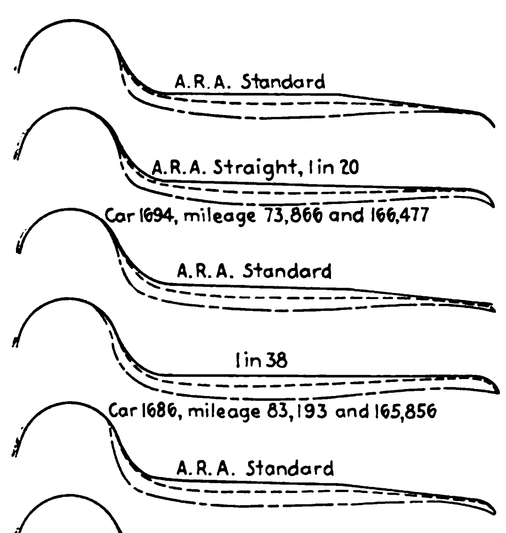


Fig. 8—Average wear of A. R. A. standard wheels compared with special contours

of the interest and work on this problem. Many of the roads have conducted tests for their own information, which were not presented at the association meetings, nor published in the railway literature. Interest in tread contours has heightened in the past decade and a number of tests are in progress at this time.

The throat radius of a tread contour is perhaps the most important part to be considered as it affects tread and rail wear, train resistance, and safety against derailment. The question in dispute is whether the throat radius should be equal to, or greater than, the radius at the top of the rail section. The first contour proposed to the A. R. M. M. A. had a ⅜-in. throat radius, and represented one school of thought at that time. The delay in the adoption of the first M. C. B. tread was caused by disagreement on throat radius as well as taper. Today the same differences of opinion exists, although the majority favor the larger radius.

When a truck with parallel axles moves around a curve it is generally understood that it tends to move on a tangent until the outer front flange strikes the outside rail. The force between the outside rail and this outer front wheel flange then diverts the truck from its tangential path by rotating the truck about its rear inner wheel. To accomplish this, the front wheels must slide laterally toward the inside of the curve; one front and one rear wheel must slide longitudinally because of the difference in length of the inner and outer rails; the rear axle naturally assumes a position radial to the curve.

It has been stated by A. M. Wellington, that the lateral force to produce the necessary sliding is constant and is not a function of the degree of curvature. The distances

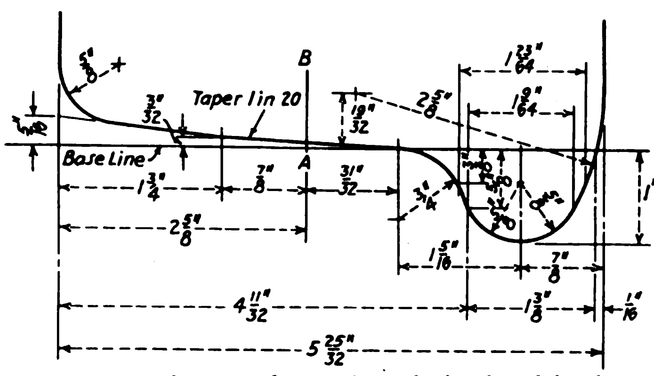


Fig. 9—Tread contour for cast-iron wheels adopted by the A. R. A. in 1928

slid through have been shown to be directly proportional to the degree of curvature. If these relations were correct, the work done in a given distance traveled would vary directly with the degree of curvature, and thus the curve resistance of the vehicle would be a direct function of the degree of curvature. It is a well-known fact that this relation does not exist in practice.

In 1885, M. N. Forney, secretary of the M. C. B., presented a paper stating that the throat radius should be the same as that of the rail section. Mr. Wellington severely criticised the suggestion with the following explanation: "Imagine a heavy sphere rolling down a plank. It has a very small bearing surface, yet any additional bearing surface which might be gained by turning the plank into a trough exactly fitting the sphere would plainly produce more friction and more wear, rather than less."

The sphere rolling down the plank is not a suitable analogy for the conditions it represents. To correct it an axis of revolution should be placed through the sphere, with one end of the axis above and in front of the normal axis. The sphere would then be partially sliding instead of freely rolling. This small amount of sliding with the high bearing pressures prevailing would cause more wear than if the sphere were rolling in the trough referred to above, where the total distance slid through

is greater but the bearing pressures very much less; particularly so if in the former case the materials are loaded beyond the elastic limit, as is often the case with wheels and rails. Tests conducted on the Philadelphia & Reading showed that decreasing the elastic limit 10 per cent by annealing rails increased the wear 31.9 per cent. Even if the wear between the ball and the perfectly fitted trough was greater than that between the ball and plank, the surfaces should adjust themselves naturally to approach the conditions of the ball and plank. The center of the trough would become a neutral line and the ball would roll on this line without excessive wear just the same as on the plank. The excessive wear on the sides of the trough would soon relieve the pressure and thus leave the ball free to roll on the center of the trough.

So far as compensation on curves for the difference in length of the inner and outer rails is concerned, there

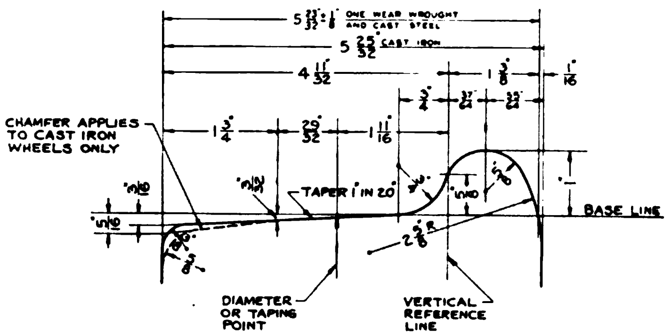


Fig. 10—Tread contour adopted by the A. A. R. in 1936 for cast-iron and one-wear wrought and cast-steel wheels

is nothing to be gained by tapered treads. The position of the outside leading wheel of a truck or locomotive is always tight against the outer rail regardless of the degree of curvature. Therefore, compensation on a front pair of wheels can be correct for a curve of only one radius. Since the rear pair of wheels either take the radial position, or tend to take that position, until the inside flange strikes the rail, any advantage in coning the front wheels would be offset by the increased sliding of the rear wheels.

The important effect of tapered treads is in the motion of a truck on straight rather than curved track. If a

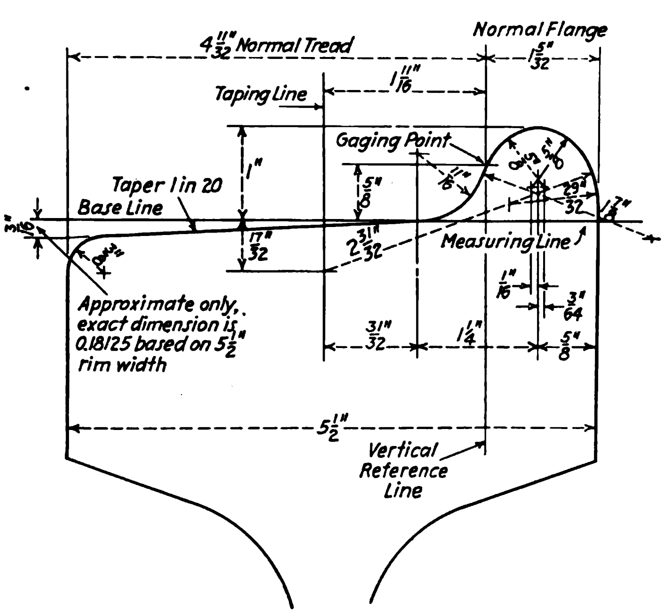


Fig. 11—Tread contour adopted in 1932 by the A. A. R. and revised in 1936 for multiple and two-wear wrought-steel wheels for cars and tenders

four-wheel vehicle with parallel axles, wheels solid on the axles, and the wheels on one side of a different diameter from those on the other side is allowed to roll freely on a plane surface its path will be an arc of a circle. The radius of this arc is not the same as that of an arc which one of the wheel pairs would describe

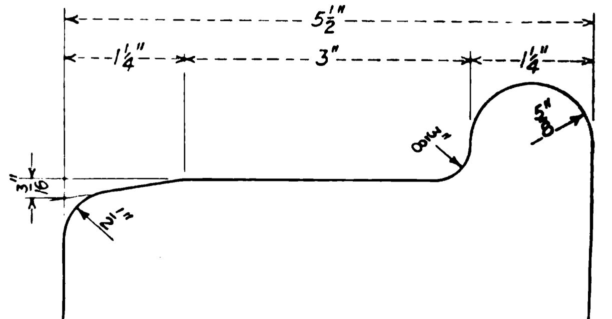


Fig. 12—Tread contour proposed by the author

in rolling singly. When a railway truck with tapered treads moves closer to one rail than to the other, the effective diameter of the wheels on this rail is increased, while on the other side it is decreased. The action described above then causes the truck to turn toward the opposite rail until it has rolled up on the larger diameter of wheels on this opposite side. This in turn causes the truck to move back again toward the other side, and thus sets up a series of lateral oscillations which might produce undesirable riding qualities in the car. Investigations in Germany many years ago, and more recently in Japan and the United States, have shown the oscillations to be in the form of sine waves with amplitudes as high as 1¼ in. on American equipment.

From the foregoing discussion it is obvious that the amount of tread taper determines both the frequency and amplitude of these oscillations. With wide wheels and sufficient taper a vehicle could be made to travel along a track, either straight or curved, without any flanges whatever on the wheels. Some railroad officers in the past have strongly advocated a taper of 1 in 13, claiming on this basis that flange pressure and flange wear would be substantially reduced by its adoption.

The lateral oscillations of trucks are not caused entirely by tapered treads. The use of cylindrical treads will produce oscillations whose amplitudes are the maximum but at a very low frequency. Even the most minute irregularity in either the track or wheel will cause a truck to move toward one rail or the other until the flange strikes that rail. The materials, being elastic, compress; the rail bends and twists; the wheel and axle bend. The work done in deforming these materials will be returned to the wheel, diverting the path toward the other rail. These statements are made with the assumption that the cylindrical wheels have been carefully paired with equal diameters. If the diameters of pairs are not very nearly the same, the truck will remain turned toward one side and cause abnormal wear.

No tests of which the author has any knowledge have shown any significant difference in wear between cylindrical treads and tapered treads. As in testing for throat wear, it is impossible to make a satisfactory road test to determine the relative wear of different tapers, because it is unreasonable, for instance, to test cylindrical treads on rails worn by wheels with a 1 in 20 taper. The results of one test of this kind are shown in Fig. 8.

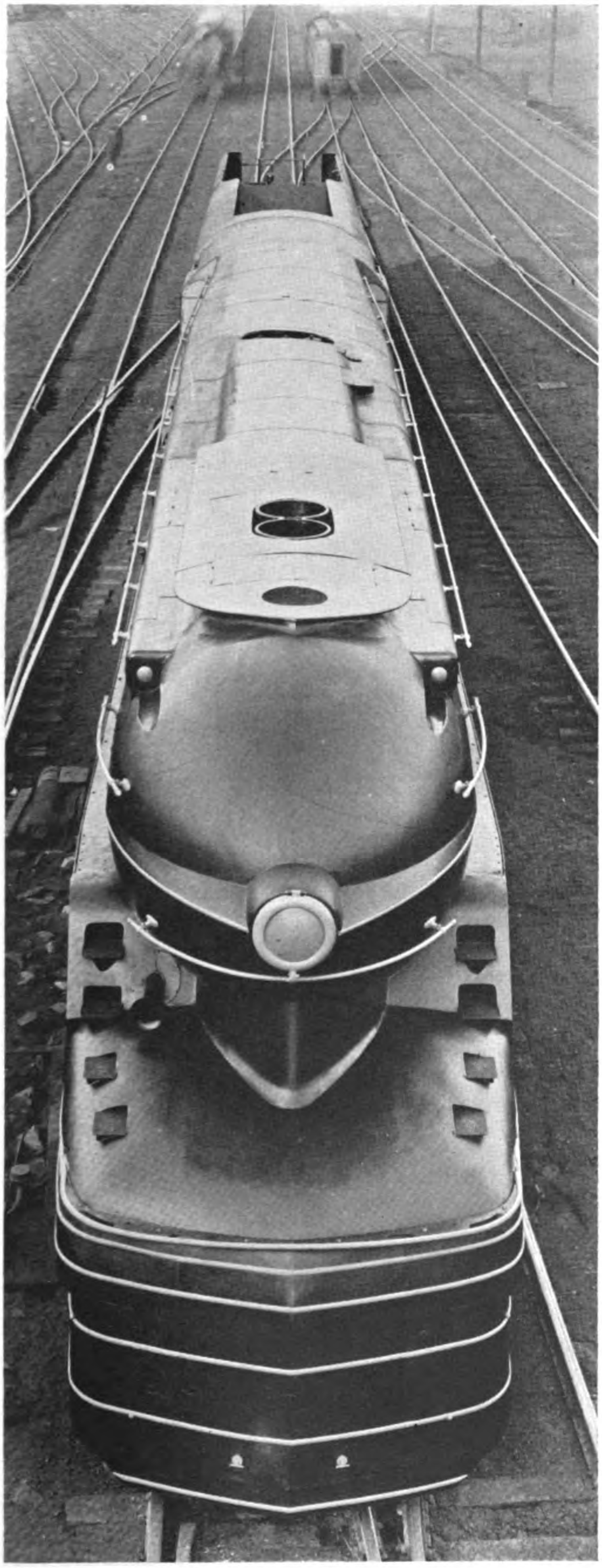
Conclusions and Recommendations

As a result of this investigation, the following con-

(*Continued on page 319*)

Unusual Details on

World's Fair Locomotive



For high-speed heavy passenger service, the locomotive built by the Pennsylvania, has two four-coupled driving units in a single bed casting—The engine weighs 608,170 lb., has a tractive-force rating of 76,400 lb., and is estimated to develop a maximum of 6,500 i.hp.

A STRIKING feature of the railway exhibit at the New York World's Fair is the locomotive of the "American Railroads" which is operating under its own steam on a demonstration stand. This locomotive has a 6-4-4-6 wheel arrangement. It was designed by engineers of the American Locomotive Company, the Baldwin Locomotive Works, and the Lima Locomotive Works, Inc., in collaboration with the Pennsylvania, and was built at the Altoona, Pa., works of that railroad. The demonstration stand is so arranged that when the driving wheels rotate, the engine-truck, trailing-truck and tender-truck wheels are also caused to rotate by the rollers on which they rest, all at approximately the same linear velocity at the trends of the tires.

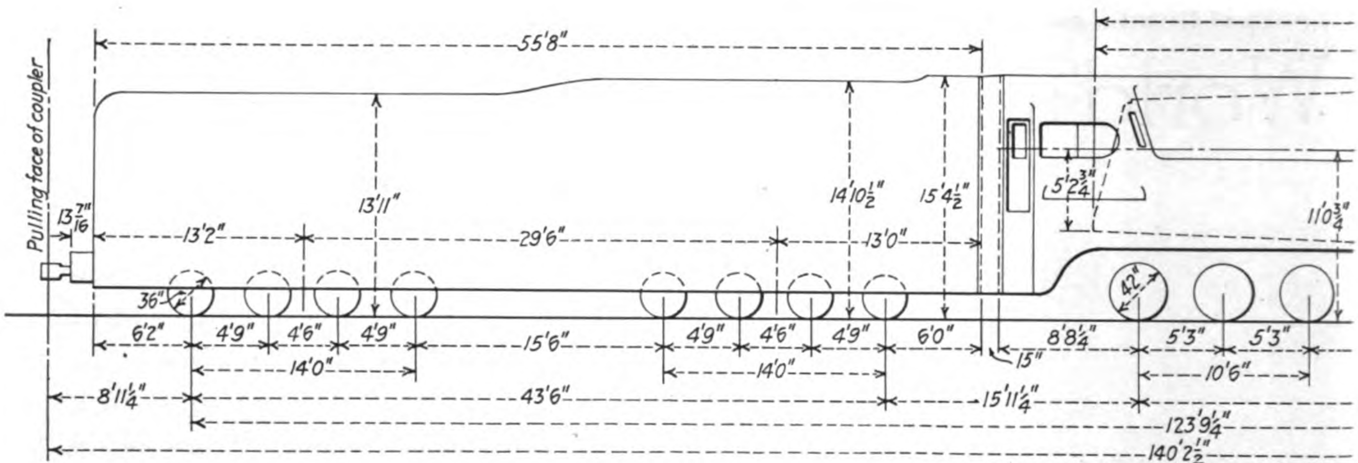
The locomotive is designed to handle heavy passenger trains of 1,200 tons at maximum speeds up to 100 m. p. h. on level tangent track. Its estimated capacity is 6,500 i. hp. As indicated by the wheel arrangement, there are two four-coupled sets of driving wheels, each driven by a pair of single-expansion cylinders, which are located ahead of their respective driving wheels, and both the engine and trailing trucks have six wheels.

Frames and Running Gear

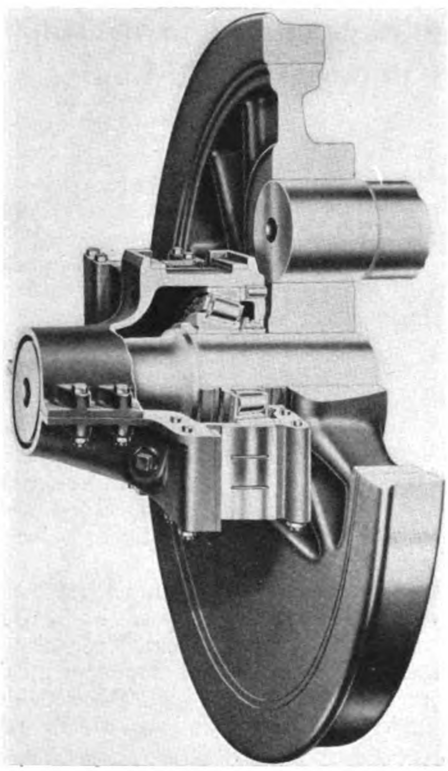
The foundation for the locomotive is a Commonwealth steel bed casting. With its two pairs of cylinders and valve chambers, including the back cylinder heads, all of which are cast integral, this bed weighs 97,620 lb., the heaviest which has yet been poured. Included in the casting is a front cylinder saddle, a forward extension from which forms the bottom of the smokebox. Pockets in the saddle portion of the casting extend down to the tops of the valve chambers and include the outside steam connection to them. In the back wall are also inside and outside flange connections for the steam pipes to the rear pair of cylinders. The cylinder spread is 92 in.

The driving wheels are of the Baldwin disc type mounted on axles with journals 12¾ in. by 13 in. The wheels are 84 in. in diameter over the tires. The journals are fitted with Timken roller bearings in split-type tubular housings. Alco lateral-motion controls are installed on the boxes of the No. 1 and No. 3 driving axles.

An unusual feature in this locomotive is the employ-



General outline and dimensions of



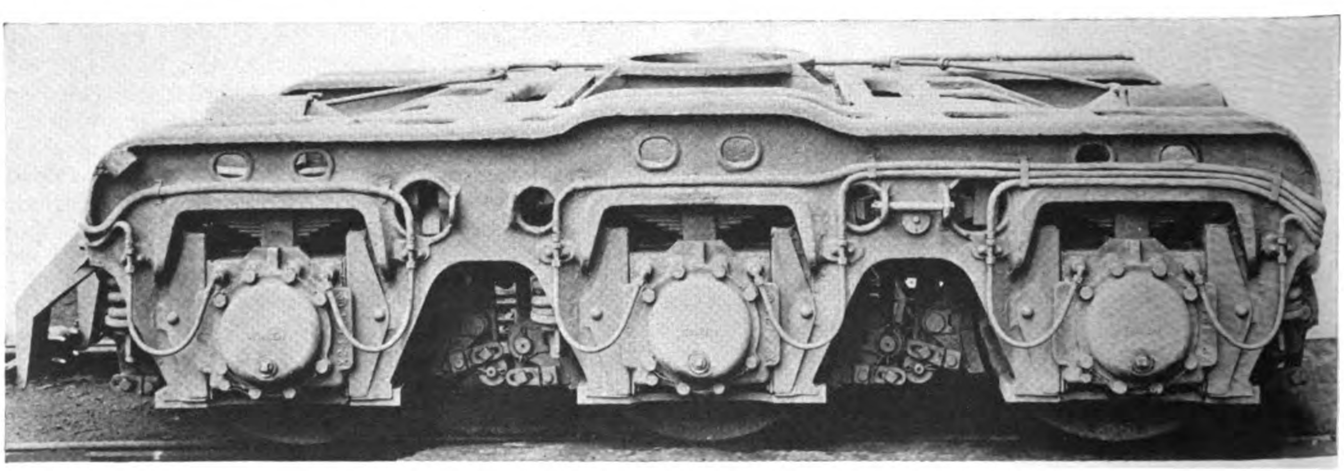
The drivers are fitted with Timken split-type tubular roller-bearing housings

ment of a stroke of only 26 in. No other high-capacity passenger locomotive has so short a stroke and to obtain it requires an offset main crank pin so that there may be sufficient metal in the wheel center between the axle and crank-pin fits. The throw of the side rod is increased by 1⅛ in. from the 13-in. throw of the back end of the main rod.

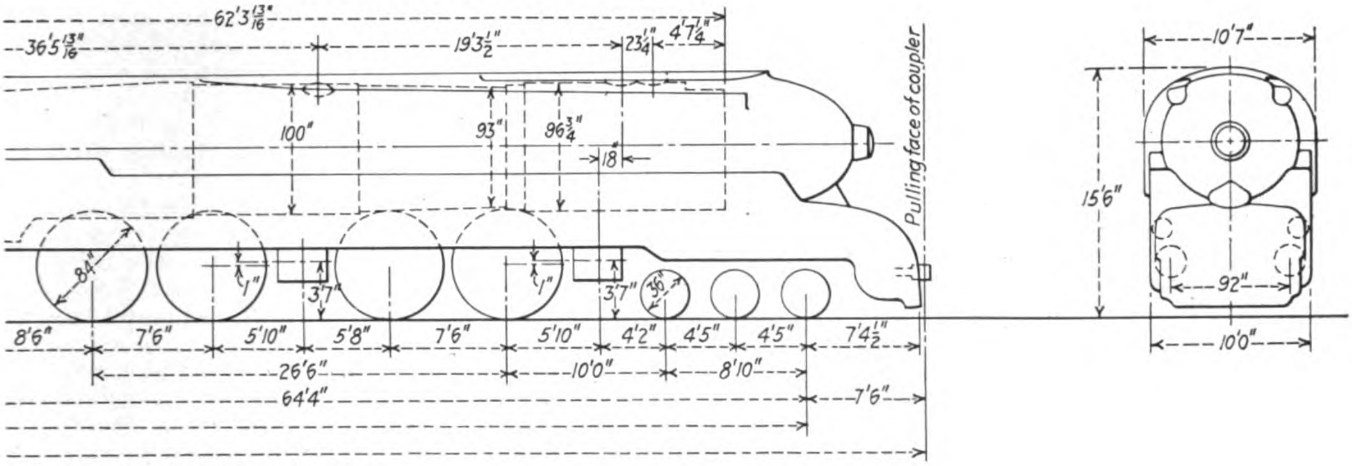
The cylinder bore is 22 in. in diameter. The piston head, piston rod and crosshead are of the Timken lightweight design employing Timken high-dynamic steel. The crosshead is the two-piece bolted type which is draw-clamped on alternate taper shoulders and recesses around the end of the piston rod. The guides are of the multi-edge type and the crosshead shoe is of aluminum alloy. The reciprocating parts on each side of each engine have a weight of 1,010 lb., 52 per cent of which is balanced.

Both ends of each side rod are fitted with spherical bushings. The convex spherical bronze bushing floats between the crank pin and the concave spherical steel bushing pressed in the rod. The main-rod crank-pin bearing is a cylindrical floating bushing.

The Commonwealth engine and trailer trucks both have six wheels. The engine truck is of the increasing-resistance geared lateral-motion type. It is unusual in that it has a three-point suspension. The leading pair of wheels are cross-equalized at the rear, while the two rear wheels on each side are equalized together. Coil springs are employed in the hangers at the front ends of the front semi-elliptical springs, at the front ends of the semi-elliptical springs over the No. 2 axle, and at the rear ends of the



The Commonwealth six-wheel engine truck has three-point suspension



the class S-1 locomotive and tender

semi-elliptical springs over the No. 3 axle. The center of the cross-equalizer at the rear of the front pair of wheels is pivoted to the truck frame.

The trailing truck is of the Delta type. The four driving wheels and the three trailing-truck wheels on each side of the locomotive are continuously equalized. Double-coil springs are inserted between the front ends of the semi-elliptical driving springs and the frame at the front ends of the No. 1 drivers and at the rear end of the trailer truck. The rear end of the locomotive is supported on the rear end of the trailer truck frame through a roller centering device.

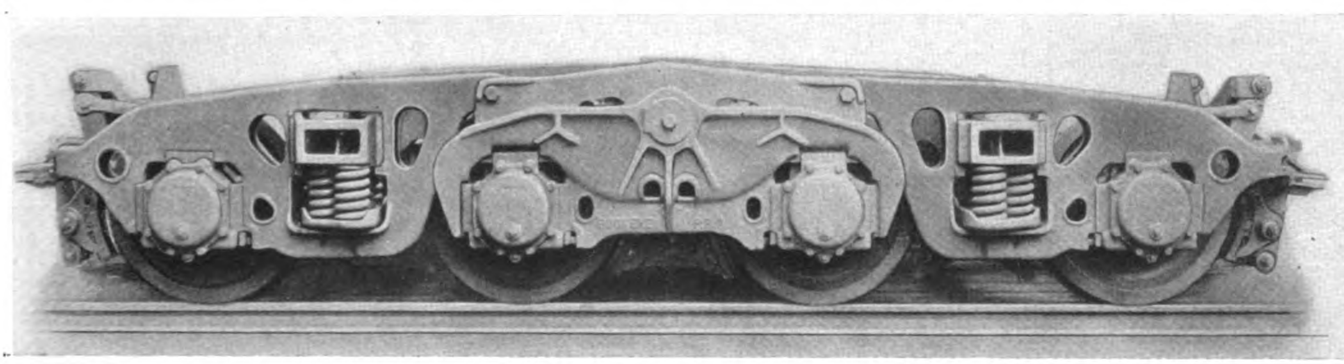
The engine-truck journals are 7 in. by 9 in. and the trailer-truck journals 8 in. by 12 in. Both trucks are equipped with Timken roller-bearing journal boxes.

The driving axles are hollow bored. The driving, engine-truck and trailer-truck axles are low-carbon nickel steel normalized and tempered. The same material is also used in the crank pins and in the main and side rods.

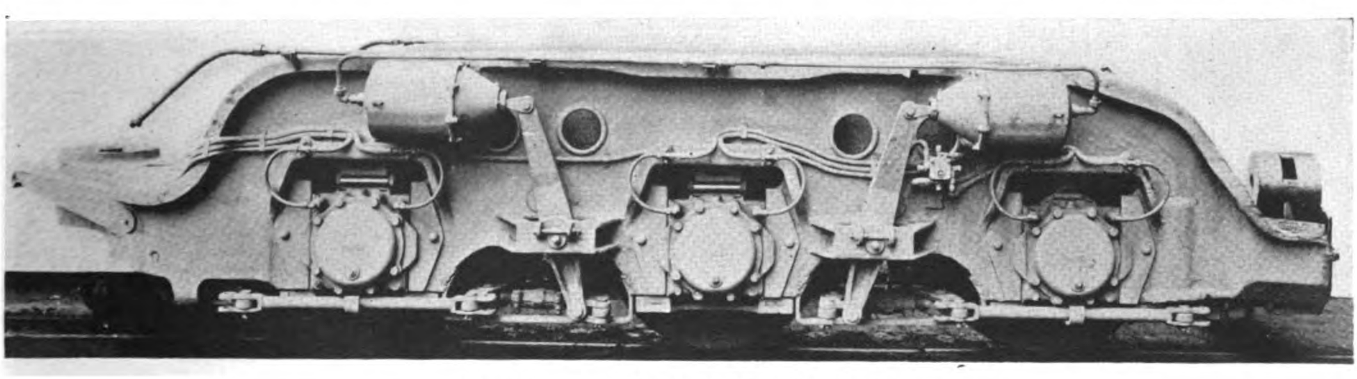
The Boiler

The boiler has 5,661 sq. ft. of evaporative heating surface and a combined heating surface of 7,746 sq. ft. It is notable for its large firebox and combustion chamber with a total radiant heating surface of 660 sq. ft. and a grate area of 132 sq. ft.

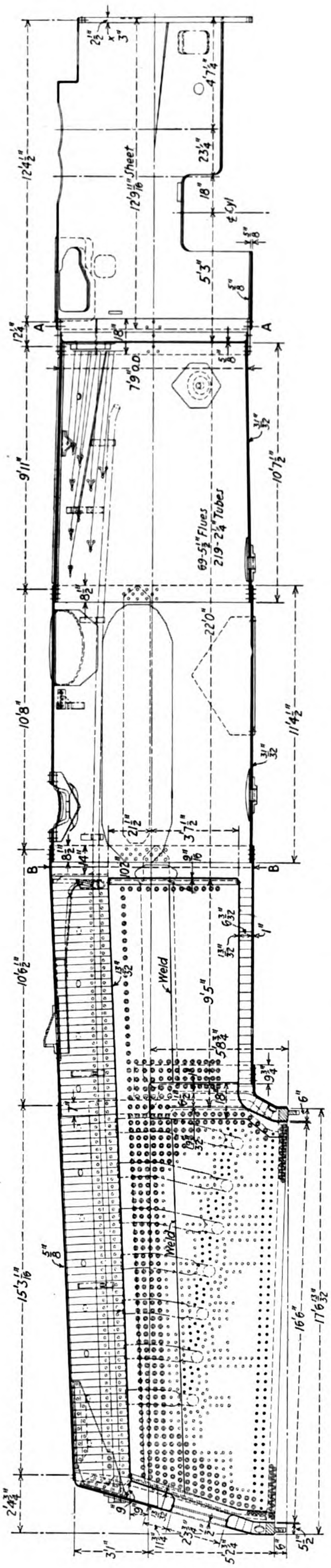
In form, it is a modified Belpaire type. The outside diameter at the first barrel course is 93 in. and at the third course immediately in front of the combustion chamber the outside diameter is 102 in. The first and third courses are tapered; the middle course is straight. Designed for a working pressure of 300 lb. per sq. in., the shell courses, liners, and outside firebox sheets are of nickel steel. The rivets are a chrome-manganese-silicon steel chosen for its relatively high per-



The Buckeye eight-wheel tender truck



The Commonwealth six-wheel trailing truck



Sectional elevation of the boiler for the S-1 class locomotive

missible bearing stresses. The front tube sheet is attached to a short connecting ring, inside of which fits the front end of the first boiler course and which, in turn, fits inside the smoke-box shell.

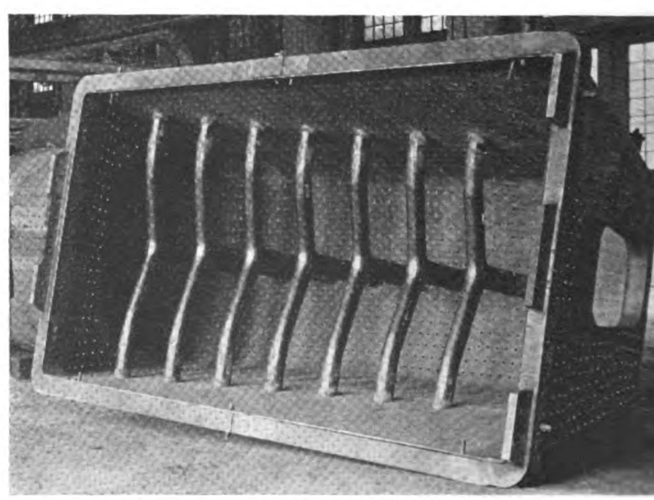
The inside firebox dimensions are 8 ft. by 16 ft. 6 in. at the mud ring, and the combustion chamber extends 10 ft. forward into the third barrel course. Immediately back of its front circumferential seam this course has been flanged to the modified Belpaire roof-sheet form. The firebox construction differs from the true Belpaire design in that the roof sheet and crown sheet cross radii are not struck from the same centers, so that the crown stays are not all of the same length.

The first two barrel courses are $^{31}/_{32}$ in. thick, and the third course and throat sheet are 1 in. Longitudinal seams are seal welded for 12 in. at the ends. The wrapper sheets are $5/8$ in., and the back-head sheet $1/2$ in. The top of the back boiler head is gusset stayed; the top of the front tube sheet is supported by rod stays.

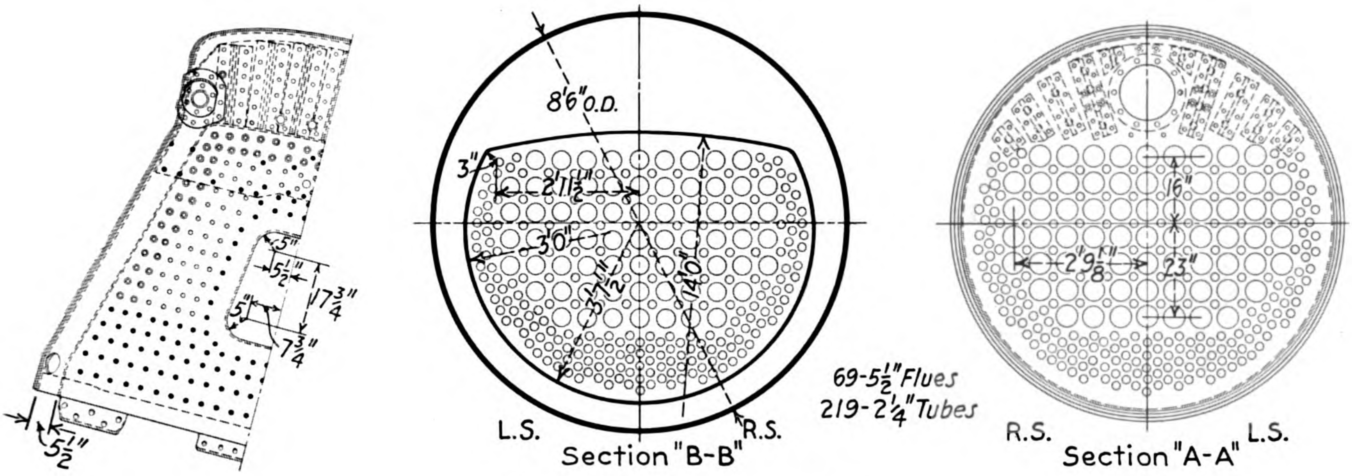
The inside firebox consists of the door sheet, the crown sheet, and two side sheets. The combustion chamber is in two pieces, and the combustion-chamber and firebox sheets are joined by a throat sheet. With the exception of the door sheet and tube sheet, all firebox and combustion chamber seams are welded. There is an extensive installation of Flannery flexible staybolts of the two-piece type with the caps welded onto the outside sheets. These include the sides and bottom of the combustion chamber, four rows along the top of the firebox side sheets, and large triangular areas at the front and back top corners. The crown stays in the four transverse rows at the front of the combustion chamber and two longitudinal rows at each side of the roof are also flexibles. Those across the front of the crown, however, have caps screwed onto sleeves which are welded to the roof sheet. Two longitudinal rows of screwed cross stays join the vertical sides of the wrapper sheets above the crown sheet.

Inside the firebox are installed seven American Arch circulators. Each consists of a $5\frac{1}{2}$-in. tube which extends across the firebox transversely and opens into the water space on either side. These tubes curve upward toward the longitudinal center line of the firebox and there merge into vertical 7-in. tubes which open into the water space at the center of the crown sheet.

There is no main dome on the boiler, the dry-pipe intake being in the form of slots along the top of the pipe inside the boiler shell. There is, however, an auxiliary dome on the left side of the center line at the front of



The inside firebox and combustion chamber—In the firebox are seven American Arch Security circulators



The back head and boiler cross-sections

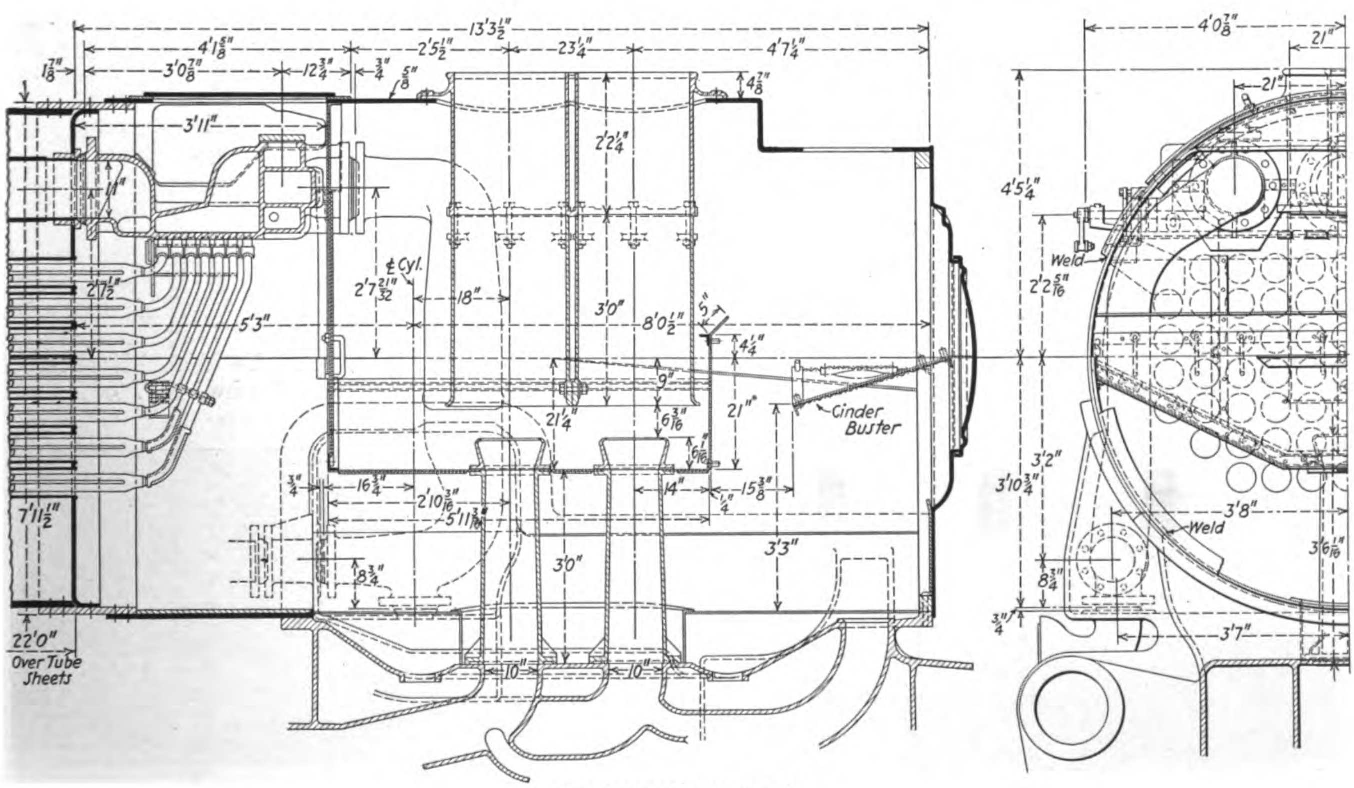
the second boiler course, with an 18 in. opening into the boiler, and a safety-valve well at the top center line near the back of the same course. This well is a heavy pressing which is mounted inside the boiler shell and depressed so that the safety valves come within the top clearance limits.

The tube sheets are laid out for a Type A superheater, with 69 double, single-pass units. The arrangement of these units is shown on the drawing of front end. The locomotive is fired by a Standard HT type stoker. The table grates are lightweight iron castings with a nickel content of 1.5 per cent and a chromium content of 0.75 per cent. The firedoor was furnished by the Standard Locomotive Equipment Company. The feedwater heater is a Worthington type 6Sa, with a type 7Sa pump. On the left side is a Sellers SW type injector. The delivery pipe for the injector extends forward from the back head inside the boiler. The boiler is fitted with mountain gage cocks, according to Pennsylvania practice for large locomotives. The intakes for these gage cocks are piped forward to a point approximately over the front end of the tube sheet. The boiler lagging is Alfol, the total weight of which is about 98 lb.

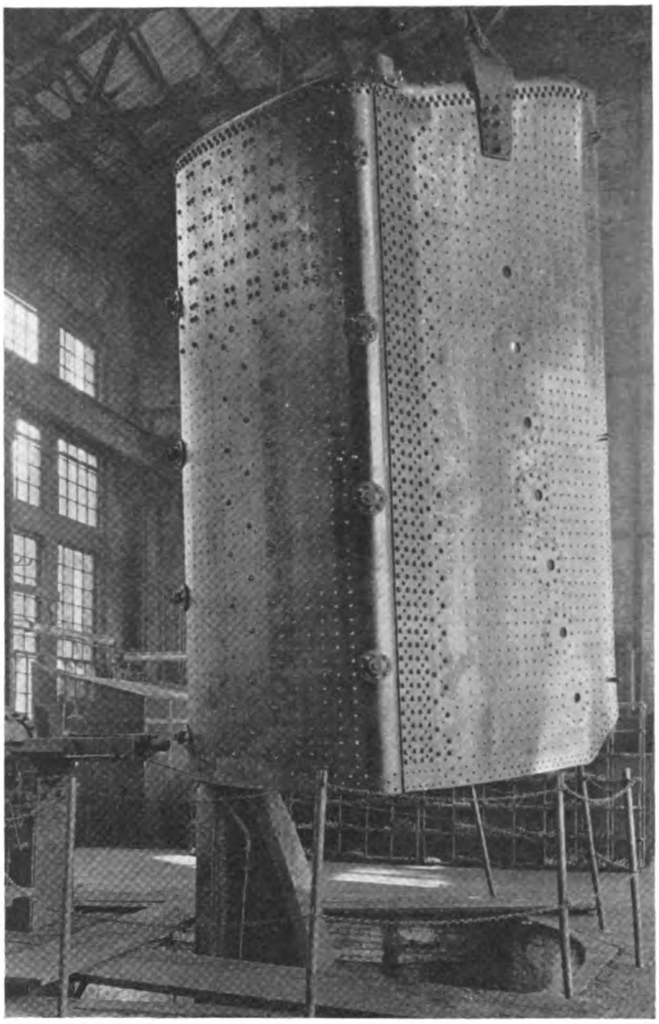
The Front End

This locomotive has an unusual front-end arrangement. There is a separate exhaust pipe and stack for each pair of cylinders. These are arranged one in front of the other, the front exhaust pipe leading from the forward pair of cylinders. Exhaust cavities below both exhaust pipes are in the bed casting. That at the front is cored to the first pair of cylinders, the center line of which is 41¼ in. at the rear of the exhaust-pipe center.

The rear exhaust cavity terminates at the face of the rear wall of the front cylinders on the center line of the locomotive. A 10-in. steel pipe leads back to the front face of the rear cylinders. A slip joint is housed within the cross member of the bed casting between No. 1 and No. 2 pairs of driving wheels. Passages from each exhaust cavity below the smokebox lead up to an opening in



The locomotive front end



The outside firebox

General Dimensions, Weights and Proportions of the Pennsylvania 6-4-4-6 Type Locomotive

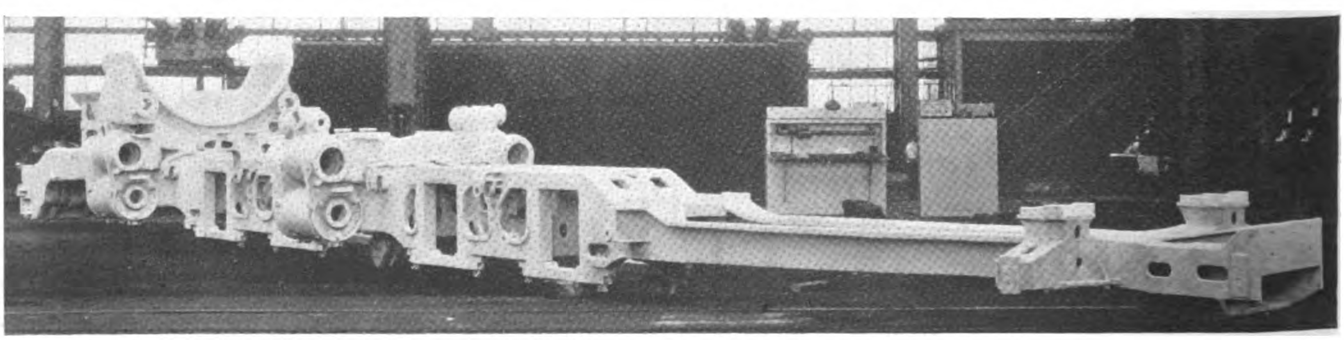
Railroad	Pennsylvania
Builder	Pennsylvania
Type of locomotive	6-4-4-6
Road class	S-1
Date built	1939
Service	Passenger
Dimensions:	
Height to top of stack, ft.-in.	15–6
Height to center of boiler, ft.-in.	11– ¾
Width overall, ft.-in.	10–7
Cylinder centers, in.	92
Weights in working order, lb.:	
On drivers	281,440
On front truck	135,100
On trailing truck	191,630
Total engine	608,170
Tender	451,840
Wheel bases, ft.-in.:	
Driving	26–6
Engine, total	64–4
Engine and tender, total	123–9¼
Wheels, diameter outside tires, in.:	
Driving	84
Front truck	36
Trailing truck	42
Engine:	
Cylinders, number, diameter and stroke, in.	4–22x26
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7½
Steam lap, in.	1⅞
Lead, in.	⅝
Boiler:	
Type	Modified Belpaire
Steam pressure, lb. per sq. in.	300
Diameter, first ring, outside, in.	93
Diameter, largest, outside, in.	102
Firebox length, inside, in.	198
Firebox width, inside, in.	96
Height mud ring to crown sheet, back, in.	71¾
Combustion-chamber length, in.	120
Tubes, number and diameter, in.	219–2¼
Flues, number and diameter, in.	69–5½
Length over tube sheets, ft.	22–0
Fuel	Bituminous coal
Grate area, sq. ft.	132
Heating surfaces, sq. ft.:	
Firebox, total	660
Tubes and flues	5,001
Evaporative, total	5,661
Superheater	2,085
Comb. evap. and superheat	7,746
Tender:	
Type	Water bottom
Water capacity, gal.	24,230
Fuel capacity, tons	26½
Trucks	Eight-wheel
Rated tractive force, engine, 85 per cent, lb.	76,400
Weight proportions:	
Weight on drivers ÷ weight, engine, per cent	46.27
Weight on drivers ÷ tractive force	3.68
Weight of engine ÷ evap. heat. surface	107.43
Weight of engine ÷ comb. heat. surface	78.51
Boiler proportions:	
Firebox heat. surface, per cent comb. heat. surface	8.52
Tube-flue heat. surface, per cent comb. heat. surface	64.56
Superheat. surface, per cent comb. heat. surface	26.92
Firebox heat. surface ÷ grate area	5.00
Tube-flue heat. surface ÷ grate area	37.89
Superheat. surface ÷ grate area	15.79
Comb. heat. surface ÷ grate area	58.68
Evap. heat. surface ÷ grate area	42.88
Tractive force ÷ grate area	578.78
Tractive force ÷ evap. heat. surface	13.49
Tractive force ÷ comb. heat. surface	9.86
Tractive force x diam. drivers ÷ comb. heat. surface	828.5

the floor of the smokebox, just inside the front-end door, from which a steam pipe leads to the feedwater heater, mounted in a recess in top of the smokebox in front of the stacks.

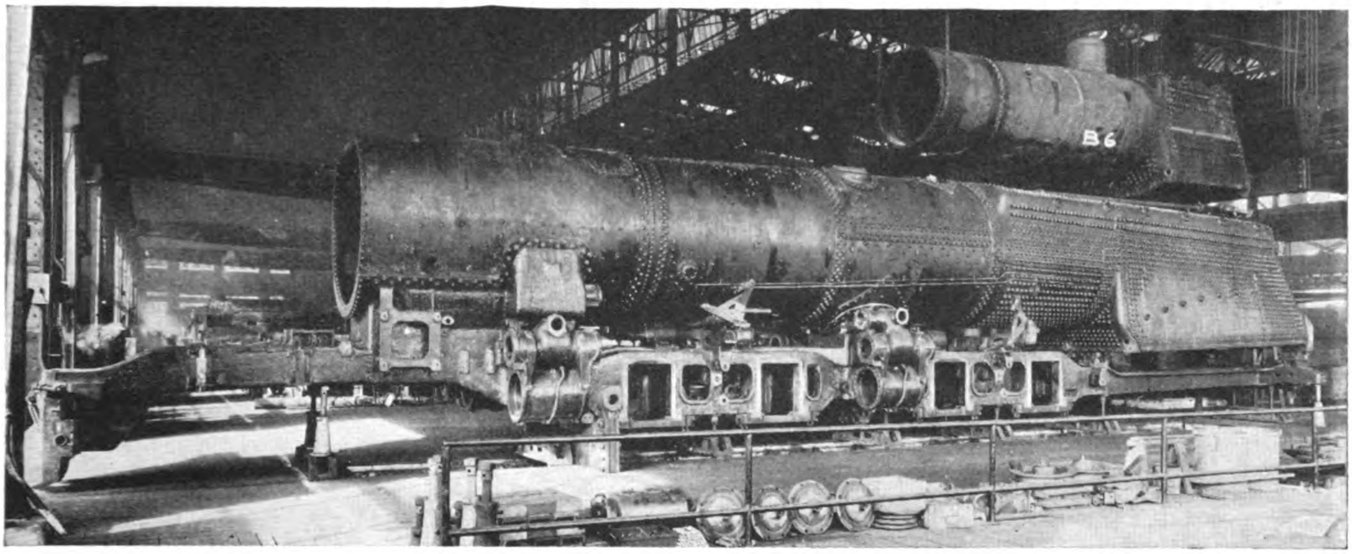
At the center, over the exhaust pipes, the table plate is 21 in. below the center line of the smokebox, sloping upward toward the sides. Extending down and back from the center of the smokebox door is a cinder-buster screen. Behind this screen is a completely unobstructed vertical passage of 15⅜ in. into the space surrounding the stacks. At the back of this passage is a vertical deflecting plate which extends up from the front of the horizontal table plate to a height of 4¼ in. above the center line of the smokebox. Behind this plate are the stacks, the extensions of which terminate 9 in. below the center line of the smokebox. The exhaust tips are of the annular ported type.

Steam Distribution

Steam distribution is effected by Walschaert valve gears which provide a maximum travel of 7½ in. for



The bed casting is 77 ft. 9½ in. long and weighs 97,620 lb.



An interesting comparison in boiler sizes

the 12-in. piston valves. All four valve motions are controlled by a single Alco power reverse gear. The reach rod on this gear is connected directly to the reverse shaft for the front pair of cylinders. A connection rod extends back to the reverse shaft for the rear pair of cylinders. Normalized and tempered low-carbon nickel steel is used for the radius rod, lap-and-lead lever, the link lifter and the union link. Carbon steel is used for the remaining valve-motion parts.

An American front-end throttle is built into the superheater header. The branch pipes from the header are each provided with a Y-connection at the lower end, one leg of the Y extending downward to the bottom of the cylinder-saddle pocket in the bed casting and the other extending back to the rear wall of this pocket. They are seated against the bed-casting openings with ball-joint rings. The branch pipe for each rear cylinder is in turn seated against a flanged extension on the outside wall of the cylinder saddle and extends back toward the steam-chest connection on the rear cylinder. This connection includes a slip-joint gland, and the branch pipe is connected to the front of the slip-joint flange. All connections are closed with the usual ball-joint rings. These outside branch pipes are lagged with Unarco Special Insubestos pipe covering, 2 in. thick.

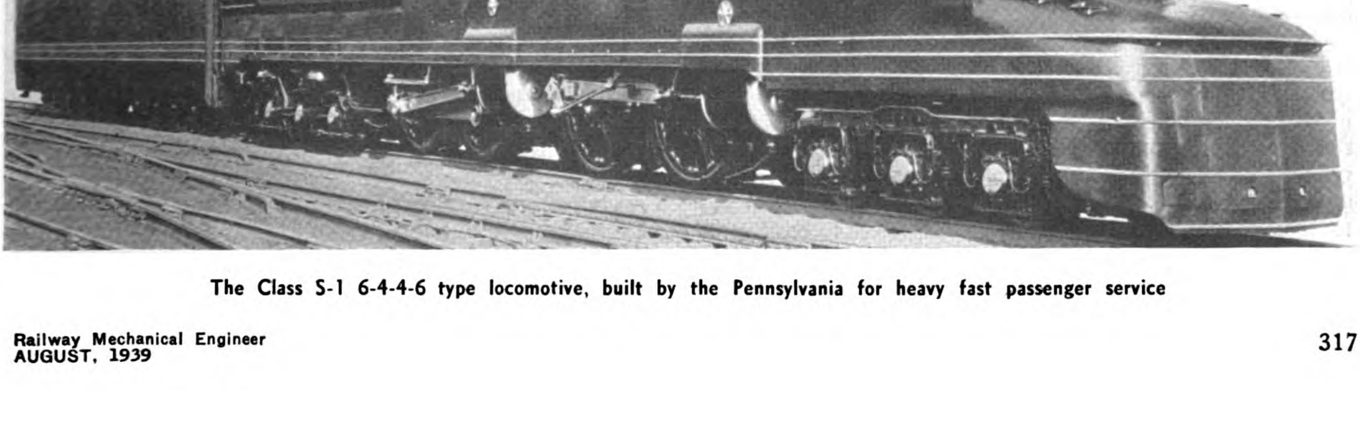
The cylinder and valve packings are Locomotive Finished Material Company lip-ring design. The piston-rod and valve-stem packings are the King type.

Lubrication

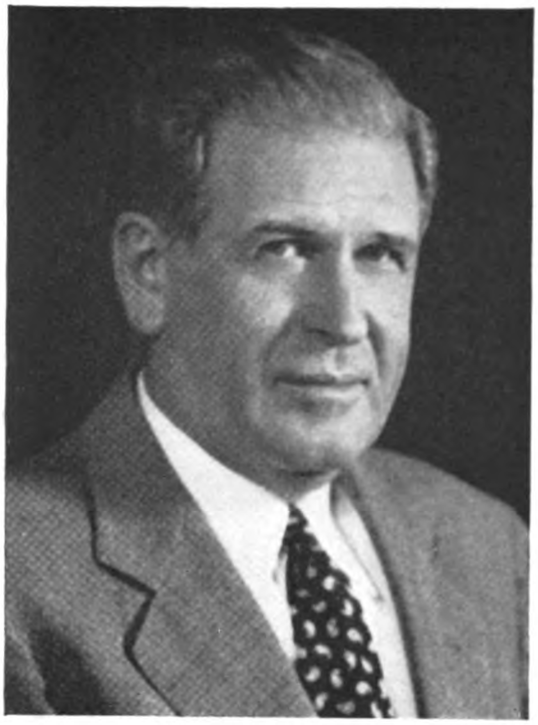
Cylinder and chassis lubrication is furnished from three Nathan DV-7 38-pint mechanical lubricators. Two of the lubricators are placed on the left side and one on the right side. Each right-side lubricator feeds one pair of cylinders and valves. There are top and bottom connections at the middle of each cylinder and a connection into the steam pipe near each valve chamber. Atomizers with steam connections from a special manifold are placed between the terminal checks and the steam-pipe and top-cylinder oil fittings. There is one oil connection to each guide. Oil lines from the front cylinder lubricators also lead to the feedwater-heater steam pipe and rear-cylinder exhaust-pipe expansion joint. Oil is fed to the stoker engine from the rear lubricator.

The lubricator on the left side of the locomotive has ten feeds, one for the pedestal shoes at each axle. Each feed line from the lubricator leads to a Nathan four-way oil distributor. From the distributor oil lines lead

(*Continued on page 319*)



The Class S-1 6-4-4-6 type locomotive, built by the Pennsylvania for heavy fast passenger service



William J. Patterson

Patterson Promoted to I.C.C.

Safety Bureau career man receives well merited recognition

William J. Patterson, director of the Bureau of Safety of the Interstate Commerce Commission, was on July 20 appointed by President Roosevelt to be a member of the Interstate Commerce Commission for the term ending December 31, 1945. Mr. Patterson takes the position formerly occupied by Commissioner Balthasar H. Meyer, whose term expired December 31, last year, and who was finally released at his own request on May 1 of this year. Thomas R. Amlie, a left-wing Wisconsin Progressive, was first nominated to succeed Commissioner Meyer, but the nomination was finally withdrawn at his own request when it became evident that the Senate would not approve it.

Mr. Patterson's nomination was promptly confirmed by the Senate on July 27; he took the oath on July 31, in order to get started as a commissioner on August 1.

A practical knowledge of railroading has never been considered a necessary qualification for a place on the Commission, and very few of its members have ever possessed such knowledge. Obviously, however, a commissioner with practical railroad experience is in a position to render a real and substantial service. Much regret was expressed when President Roosevelt failed to reappoint former Commissioner Frank McManamy, who like Mr. Patterson was a career man, rising from the ranks in railroad work before entering government service, and climbing to the top.

Mr. Patterson started in as a call boy and is a former fireman, brakeman, switchman and conductor. He has been a member of the I.C.C. staff since 1914. As director of the Bureau of Safety he insisted upon strict compliance with the law, but with such tact and diplomacy that he encouraged a fine spirit of co-operation—an important factor at any time, and particularly so during the difficult economic period through which we have been passing. In the effort to cultivate better understandings and relationships Mr. Patterson frequently attended and took part in meetings of railway associations and railway clubs and has a wide personal acquaintance among railroaders of all ranks, and particularly in the mechanical and the operating departments. The new commissioner was one of five men recommended by the railway labor organizations. When in railroad service he was active in the affairs of the Order of Railway Conductors and he became an inspector of safety appliances at the invitation of Edgar E. Clark, a former president of that organization, who served on the commission from 1906 to 1921.

Mr. Patterson was born at Neenah, Wis., on June 4, 1880. In 1896 he entered railroad service as a call boy in the superintendent's office of the Wisconsin Central at Stevens Point, Wis., remaining in that position for two years. In 1898 he was employed as a brakeman on the St. Paul division of the Chicago, St. Paul, Minneapolis & Omaha. In the spring of 1899 he went to the New Mexico division of the A. T. & S. F. as a locomotive fireman, returning to the Wisconsin Central in the summer of 1899 as a brakeman and switchman. He was promoted to conductor of that road in the spring of 1902, remaining in that position until the summer of 1906, when he went with the Northern Pacific in that capacity on the Fargo and then on the Dakota and Seattle divisions, until September, 1914, when he entered the service of the Interstate Commerce Commission as an inspector of safety appliances. In August, 1918, he was promoted to assistant director of the Bureau of Safety, and on March 1, 1934, succeeded Wilfred P. Borland, who retired at that time, as director.

In speaking at the October, 1937, meeting of the New York Railroad Club Mr. Patterson pointed out that, "During the past 25 years the general trend of railway accidents has been downward, and during the past 10 years there has been a very material decline in accidents in train operation." He ascribed this improvement to "co-operative effort by railroad employees, railroad companies and government agencies." In commenting upon modernization of the services he pointed out that the continuance of the enviable safety records of the past few years should be prerequisite to the adoption of innovations in equipment or practice.

World's Fair Locomotive

(*Continued from page 317*)

to the front and back pedestal shoes on each side of the locomotive. The lubricators are driven by connections to the valve-motion links.

Alemite lubrication is used at various locations on the valve motion, crosshead guides, spring rigging, brake rigging, driving box lateral motion spring seats and throttle operating mechanism.

Brakes

The locomotive is equipped with two Westinghouse cross-compound air compressors and D-22-L air brakes with the controlled-emergency feature. This brake comprises the M-40-A automatic brake valve, S-40-B independent brake valve, D-22-E control valve and B relay valve. This is the locomotive equipment customarily employed with HSC type train brakes, except that it does not include the electro-pneumatic features. These, however, may be added in the future.

The M-40-A brake valve provides the same predetermined brake-pipe reduction in the first-service position and permits the emergency application on the second locomotive with the brake-pipe cock closed in double heading, as is available with the No. 8 ET brake. Its controlled emergency feature for operation in freight-train service is also the same as with the No. 8 ET equipment. The S-40-B independent brake valve is of the self-lapping type. With the B relay valve brake-cylinder pressure on the locomotive is maintained from the main reservoir.

Clasp brakes are applied on all wheels of the locomotive. The driving brakes are operated by one cylinder for each pair of wheels.

Cab and Cab Fittings

The auxiliary steam supply is taken from a small cast-steel fixture riveted to the roof sheet over the combustion chamber. This casting, the longitudinal section of which is triangular, has a vertical rear face from which the steam pipe leads back to the front of the cab. Steam for the blower is piped directly from the saturated-steam side of the superheater header.

The locomotive is fitted with a Union Switch & Signal continuous inductive cab signal installation.

Sand pipes are placed in front of both drivers of the front engine and in front of the back pair of drivers of the rear engine. There are four sandboxes, two on each side of the locomotive, behind the cowling below the running boards. Filling caps are accessible through the running boards. The sanders are Graham-White. In brake applications they may be operated by depressing the brake-valve handle and in emergency applications the sanders are operated automatically. There is also an independent sander valve.

In the design of the streamlining of the locomotive and tender, Raymond Loewy served as consultant. In general, the lines are similar to those first applied to a K4s locomotive, No. 3768, including the same type of smoke lifter. The cab and the bullet-nose front-end are of aluminum. Behind a removal panel in the shrouding over the pilot is mounted a folding coupler which was furnished by the McConway & Torley Company.

The Tender

The tender has a water capacity of 24,230 gallons and a coal capacity of 26½ tons. It is of welded construction, built on a Commonwealth cast-steel water-bottom underframe 58 ft. 10¼ in. long and weighing 43,060 lb.

The eight-wheel tender trucks were furnished by the Buckeye Steel Castings Co. The wheels are 36 in., in diameter and are mounted on 6½-in. by 12-in. axles, fitted with Timken roller bearings. This truck employs a modification of the type of equalized frame construction which is the feature of the Buckeye six-wheel trucks.

The clasp brakes are of the vertical-lever type and are actuated by two 14-in. by 10-in. brake cylinders mounted on each truck. Braking power is about 108 per cent of the light weight of the tender at 50 lb. per sq. in.

On the front end of the tender is a Franklin E2 type radial buffer. Barco flexible connections are used between the engine and tender. The steam-heat connection at the rear of the tender was also furnished by this company. There is a National tight-lock coupler at the rear end of the tender.

Railway Wheel Tread Contours

(*Continued from page 310*)

clusions have been reached, some of which have been based on practice and some on theory:

1—The developments of the standard treads in the past have been by ballots and not based on scientific research. The adoptions were accomplished only by compromising between widely differing opinions, all of which could not have been correct.

2—The throat radius of a tread contour should be the same as the radius of the rail section at that point. The theory upon which present practice is based is not correct.

3—Theory and practice both indicate the cylindrical tread preferable to a tapered one.

4—In order to realize fully the economies of any "correct" or "best" tread, it should be adopted and used unanimously by all roads interchanging equipment. Even then it would be several years before beneficial results are apparent.

5—So far as throat radius and taper are concerned, there should be no difference in treads of different materials such as cast iron, cast steel, rolled steel, etc.

6—The desirability and amount of chamfer on the outside of a tread is determined largely by the nature of the track over which the wheel rolls in service. On divisions where most of the track is straight a large chamfer is desirable, where on divisions made up almost entirely of curves no chamfer is necessary. Since cars in interchange move on all kinds of track, a compromising chamfer should be used on a standard tread.

7—A simple contour is proposed for all wheels in Fig. 13.

8—The problem of tread contours is of sufficient magnitude in economy and safety, that further investigation is unquestionably justifiable. The writer hopes to find it possible to continue the study in the future by the use of models.

Illinois Central Publishes "Streamline" Timetable.—Schedules, in the new timetable which is printed in a different style of type, have been reduced in size, showing only the towns at which trains make regular stops. Other stations are shown in a separate index. New maps, correctly drawn to scale, show various sections of the Illinois Central system. Other features are a brief suggestion on how to read the folder, a comprehensive table of contents, and a table of railroad and Pullman fares. On the front and back covers of each new folder will be interesting pictures of scenes in Illinois Central territory.

EDITORIALS

The Boiler-Patch Contest

In the March issue we announced a first prize of $30 and a second prize of $20 for articles describing the most interesting and difficult problems of boiler-patch fabrication or application submitted to us before May 15. In all, descriptions of twenty-eight patches were submitted. All but one or two of them presents problems which have some one or more elements of interest; several of them reflect the exercise of great ingenuity in some aspect of their design, fabrication, or application. The problem of selecting the winners from among them was a difficult one indeed.

The first prize is awarded to Fred W. Strachauer, district boiler inspector, Southern Pacific Company, Sacramento, Calif. A drawing of the patch which he submitted and a brief description of the conditions which had to be met appears elsewhere in this issue.

The second prize has been awarded to J. E. Harrison, general boiler foreman, Central of Georgia, Macon, Ga. The description of this patch will appear in an early issue. Descriptions of other patches will also be printed in subsequent issues.

Some Aspects of Smoke Prevention

"We are living in an era when conditions which were tolerated in years gone by no longer can be permitted. Not so long ago the railroads constituted the principal transportation agency and coal was, as a general rule, the only, or at least the most convenient and economical, means that could be converted into mechanical energy. We had not as yet learned to appreciate that mechanical power through the medium of steam could be created with as little smoke and dirt surrounding the operation as we have learned to appreciate it today, and for that reason we did not object to the same degree that we do today when we observed the smoke clouds, whether they came from locomotives or from stationary boilers. Today, we know that much of this smoke is not necessary and, for that reason, we should not tolerate unnecessary violations."

Thus wrote John Bjorkholm, assistant superintendent motive power, Chicago, Milwaukee, St. Paul & Pacific, in his paper presented before the meeting of the Smoke Prevention Association at Milwaukee, Wis., during June of this year.

Consciousness of the nuisance of smoke from factory and locomotive stacks goes back farther than the memory of living railroad men. Nor are organized efforts at abating the nuisance much newer. In Chicago the first smoke ordinance was passed in 1881. It lacked definition and relied on health and police departments for enforcement. Penalties were the only tools and they did not prove to be very effective. However, it soon began to be recognized that smoke abatement was not a matter of enforcing penalties, but one of education and leadership in the development of co-operation between the law-enforcing agencies and all of those having to do with the combustion of bituminous coal on grates.

Evidence of the early consciousness of the public in large cities may be seen in the electrification of the terminals within Manhattan Island and the serious consideration which was being given to similar proposals at Chicago as early as 1908. Outside of a few of the largest cities, however, the people of America have largely been content to put up with a large degree of nuisance from smoke—both that from locomotives and that from industrial chimneys as well—with occasional campaigns for its supression, because it was considered, in a large degree, as a necessary evil.

Mr. Bjorkholm points out that there are reasons for a change in this generally tolerant public attitude. There are two such reasons. The first is, as Mr. Bjorkholm points out, the fact that, so far as locomotives are concerned, it is unnecessary to produce smoke in sufficient quantities or for long enough periods at a time as to become a nuisance. The second is the constant improvement in other conditions having to do with dirt, such as paved streets and the widespread influence of modern plumbing in the promotion of increasingly fastidious standards of cleanliness.

That the steam locomotive is perhaps less generally the subject of criticism in the matter of smoke emission today than thirty years ago is striking evidence of the way in which skill in dealing with locomotive conditions, firing practice and the firing up and storing of engines at terminals has kept pace with the growing acuteness of the public consciousness of air-polluting agencies. The program, however, grows in extent as time passes. The portions of railroads outside of the larger municipalities where vigilance in the prevention of smoke can be relaxed will continue to grow shorter and shorter.

One influence which, no doubt, has effected tangible improvement in the situation at terminals is the growing use of Diesel-electric locomotives in switching service. Where such power goes into main-line service, however, it will, no doubt, have the effect of pointedly calling attention to the faults of the steam loco-

motive whenever vigilance in smoke prevention is relaxed.

As pointed out in the paper from which our opening paragraph was quoted, the equipment of the coal-burning locomotive with suitable devices for the prevention of smoke formation and supplying it with properly prepared coal are as important a part of smoke-prevention activities as education and discipline of the man in the cab.

Machine Accounting Promises Notable Economies

A revolutionary improvement in railway accounting and statistical work is now under way and seems due to be widely extended in the next few years by the installation of modern machines which will make available to locomotive-shop, car-shop and enginehouse supervisors a detailed knowledge of both labor and material costs which they never had before. Moreover this information will be furnished with such speed (within four days of the conclusion of each seven-day period) as to furnish a very definite and invaluable check on both the scope and efficiency of shop operations.

On one mid-western railroad where this mechanized accounting has been extensively installed, for example, the company has concentrated at its main office 66 high-speed automatic bookkeeping machines in a well-lighted, sound-proof, 40-ft. by 90-ft. room. Twenty-six of the machines are automatic duplicating key punches; two machines perform gang work by reproducing or duplicating automatically; four machines are used to cross check the accuracy of cards already punched; twelve machines automatically sort pre-punched cards into any desired combination at the rate of 400 cards per minute for each sorting; one machine known as the collator merges cards for the multiplier; two machines receive pre-punched cards and automatically multiply the amounts in designated columns by the amounts in other cards; four machines when connected to the tabulators automatically punch the calculating machine total into other cards.

While this sounds like a large aggregation of complicated machinery, and is just that, the method of operation is relatively simple, smooth and highly efficient. Some idea of the magnitude of the operation can be gained from the fact that in a single month the work handled on these accounting machines for the mechanical department alone amounted to 150,000 units for individual locomotive repairs; 80,000 units for shop labor distribution and 180,000 units for shop material reports. The speed and flexibility of the mechanized accounting system referred to is well indicated in the following two paragraphs quoted from a descriptive article recently published in a railway trade publication:

"This method of accounting for material while permitting greater accuracy, uniformity and speed in the entire operation at less expense and confusion, has also permitted the production of statistical reports which were not previously available and it has given great flexibility to accounting and statistical work. Price lists may now be printed on the machines from the master price cards and furnished the mechanical or other departments to keep them informed as to the cost of materials being used, simply by running the cards through the alphabetical printer. Comprehensive statements of quantities of different kinds of material consumed by the road can also be prepared.

"One of the more recent by-products is the monthly statement of locomotive repairs in which the cost of labor, the cost of material and the cost of other items of expense are given for the current month and on an accumulated basis by divisions, classes of power and by individual locomotives. Detailed reports of the cost of operating and maintaining this railroad's Diesel power are also prepared at the present time and a more efficient budgetary control of expenses at different shops has been introduced in the form of a seven-day statement showing the cost of material used at different shops—a statement which is made available within four days after the close of business in any week for any seven-day period."

With these striking results not only promised, but actually achieved in a specific case, mechanized railway accounting seems in a fair way to be rapidly and widely extended.

The Freight Conductor's Private Car

In earlier days, freight trains proceeded over single divisions of 125 to 150 miles, at the end of which the entire crew on each train was changed, the locomotive sent to the enginehouse and replaced by another locomotive with a relief engineman and fireman, and the caboose switched to a yard track, being replaced by another caboose with its conductor and brakemen.

The inefficiency of this method of train operation, particularly as regards low mileage secured from locomotives, became apparent quite a number of years ago with the result that operating divisions were consolidated, individual locomotive mileage greatly increased and attendant economies effected. If this proves to be good practice with locomotive equipment, why is it not applicable to a more general extent than is now the case with cabooses? True, the amount of investment involved is in no way comparable, but the extra delay and cost of switching cabooses to and from trains is by no means a negligible factor and appears well worth consideration in any intensive effort to reduce costs.

In a discussion of this subject by a group of practical railway officers not long ago, one of the men said "I should like to ask one question of some one in the mechanical department. I am interested in switch-engine fuel as well as other kinds. I don't know why they have built such wonderful freight cars, yet they cannot

build a way car which will run over 100 or 150 miles without having to place another one on." The reply was "The best way I can answer is by saying the one unfortunate thing on the railroad is that we have two classes of people on the division with private cars, the superintendent and the conductor; they both like to keep them." Undoubtedly, a railroad freight conductor would prefer to use the same caboose on regularly assigned runs, but it may well be questioned if this is in all cases absolutely necessary and desirable in view of the increased amount of caboose equipment required and the additional switching with associated costs which this practice entails.

Making One Job Pay for Another

Without question one of the most important factors in assuring that the service obtained from car-wheel and axle units in these days of high speeds both in passenger and freight operation is the wheel shop in which the work of preparing these parts for service is done. Several times in recent months attention has been directed to the fact that many of the wheel shops, even on the larger roads, are not all that may be desired from the standpoint of meeting the recommendations of the Wheel and Axle Manual and it has also been pointed out that in many cases it is a rather difficult matter for those who are responsible for wheel-shop operations to do the best possible job because of shortcomings in the matter of shop equipment.

Shop equipment in the wheel shop, as in most any shop doing a similar type of work, may be classified under three general groups—the machine tools, the small tools, and the parts-handling equipment. By the latter is meant the cranes, hoists, trucks and special handling devices. All three of these groups of shop equipment have a direct influence on the cost of doing work. Machine tools are expensive and, unless there is a distinct advantage from the standpoint of time and cost saving, most shop supervisors have difficulty in getting all the new machinery that they would like to have. The efficiency of performance of the small-tools group many times has a decided influence on the ability of the machine-tool group to deliver the performance which the manufacturers have built into their machines. Upon the last group—that of parts and materials handling—rests, we believe, one of the most important responsibilities of all—that of getting the part or the material to and away from the machine quickly in order that production may proceed at the most rapid, or at least at the demand rate. Without going into much detail, any shop man can make a brief operation-time analysis of the relation of machining time to handling time and will unquestionably be amazed at the small proportion of an eight-hour day that is actually taken up in machining operations on a given job. The boring of car wheels and the mounting of the wheels on the axles is a case in point. This means that unless adequate and efficient handling equipment is included in the shop inventory, it is probable that a large part of the machine and tool efficiency is discounted.

This issue includes an article describing the steps taken to eliminate some of the lost motion in one wheel shop; another appeared in the June issue. An investigation in your own shop may disclose that if more attention is paid to handling problems, enough will be saved to pay for some of the new tools that are needed.

New Books

MACHINE DESIGN. *By Stanton E. Winston, A. B., B. S., A. M., M. E. Published by the American Technical Society, Chicago. 333 pages, 5½ in. by 8½ in., illustrated. Cloth bound. Price, $5.*

"Machine Design" is described as "A text presenting those fundamentals of theory and analysis which are basic to the field of machine design," in which the author has attempted to select that material which is most basic to the field of machine design in general. The material is based on the assumption that the student has completed the subject of mechanism and that his mathematical training has extended only through trigonometry and logarithms. No resort having been made to the calculus, several rational formulas are included for which no derivations are given, but the solutions of many examples are worked out in detail in this book which is of the "how-to-do-it" type.

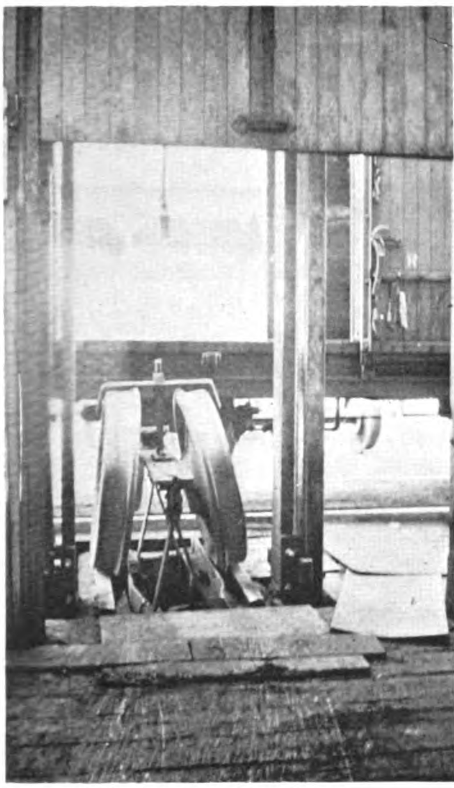
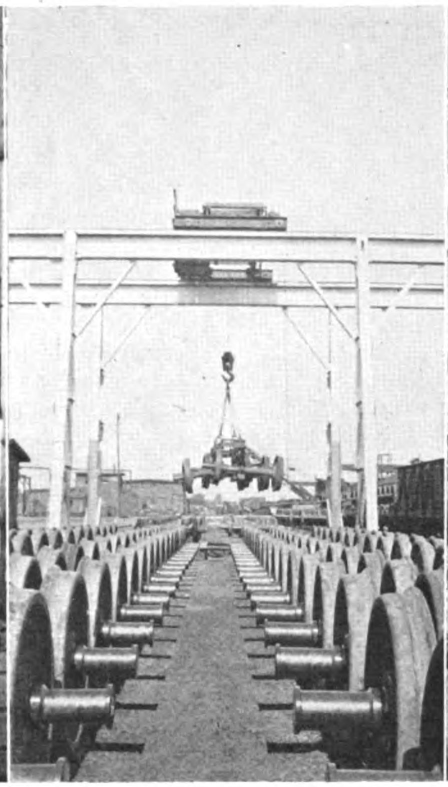
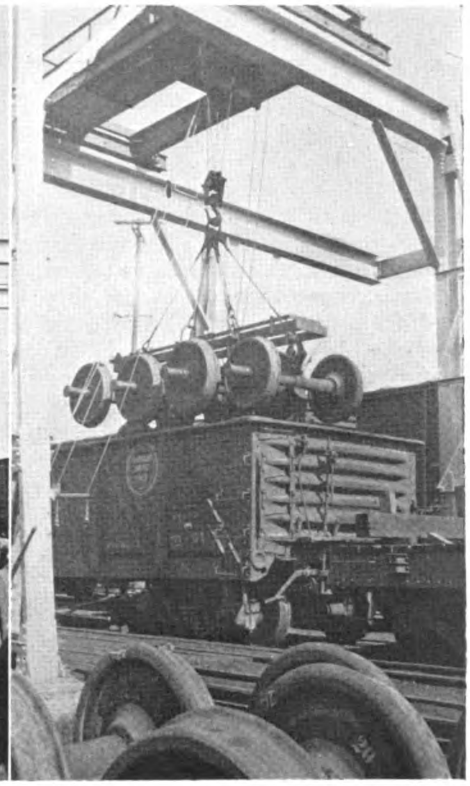
THE ENGINEERS' MANUAL. *By Ralph G. Hudson, S.B., professor of electrical engineering, in charge of the courses in general science and engineering at the Massachusetts Institute of Technology. Published by John Wiley & Sons, Inc., New York. 340 pages, 5 in. by 8 in. Price, $2.75.*

Engineering formulas, mathematical operations and tables of constants in most constant use have been consolidated in systematic order in this second edition of The Engineers' Manual, which is of pocket size. Each formula is preceded by a statement in which its application, the symbology of the involved physical quantities and definite units of measurement are indicated. The sequence of the formulas is based generally upon their order of derivation so that the understanding of a formula may be enlarged by inspection of the formulas which precede it. All catchwords, symbols and formulas are printed in bold type and each formula or group of formulas is numbered to facilitate reference to the text or cross reference between formulas. The entire chapter on Heat and a large part of the chapter on Electricity have been rewritten and brought up to date. Revisions and extensions of tables of physical constants have also been made, as well as additions in the way of new steam tables, recomputations of conversion factors affected by the latest definition of the British thermal unit, and an enlarged table of conversion factors.

With the Car Foremen and Inspectors

Missouri Pacific Reorganizes Sedalia

Wheel Shop Work

Scrap wheel elevator in loading position—Loading mounted car wheels with the Reeder device

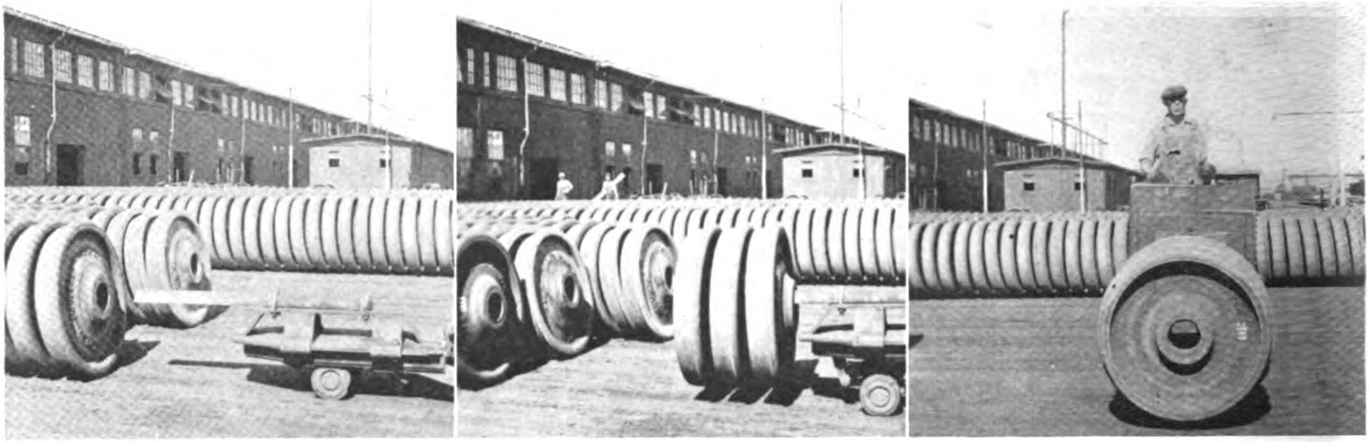
THE wheel shop at the Sedalia, Mo., shops of the Missouri Pacific has been rearranged and facilities added in order to handle all cast-iron car-wheel work for the western and a portion of the southern district of the railroad. The shop is located in the west end of the planing mill and it was desired to handle both new and old work without any interference. This is done by utilizing three doors located in the west end of the shop. The old wheels and new axles are handled along the north side of the shop moving into the center and out of the center door for distribution. The new wheels are handled along the south wall, also moving to the center and out of the center door for distribution. The above describes in a general way the routing of the work.

About 290 ft. west of the shop is a 10-ton traveling crane, operating over a track on which incoming bad-order wheels are received on flat cars and mounted wheels loaded on the same cars for shipment, also wheel tracks leading into the north and center doors of the shop and a track to the south on which new wheels are moved enroute to the shop. This track is available for handling flat cars with mounted wheels if the north track is not available.

A car of bad order wheels is received, set under the crane and six pairs of wheels unloaded at each lift by using the Reeder unloading device, illustrated, the car moved with a car spotter and another lot of six unloaded, this process being repeated until the car is unloaded. As the wheels are unloaded they are placed on a wheel track which slopes gently to the north door *A* of the shop, so that with a light push the wheels gravitate to the shop.

These wheels are inspected on the way to the shop. Just inside the door to the left is located a journal lathe, made from an old axle lathe and equipped with a Hagen end drive which revolves the axle by friction, operating at 150 to 280 r.p.m. with a $\frac{1}{32}$-in. feed. Such wheels as require journal turning are diverted to this machine where journals are turned and rolled. Those that require this operation only pass over the line of entering wheels to the center track on which they gravitate back to the traveling crane through door *B*. Such wheels as require wheels removed are placed back on the track and move onto the wheel press which is the next machine and used only for dismounting.

From this machine the scrap wheels are moved to an



Lift truck arranged for handling three wheels from the storage platform to the boring mills

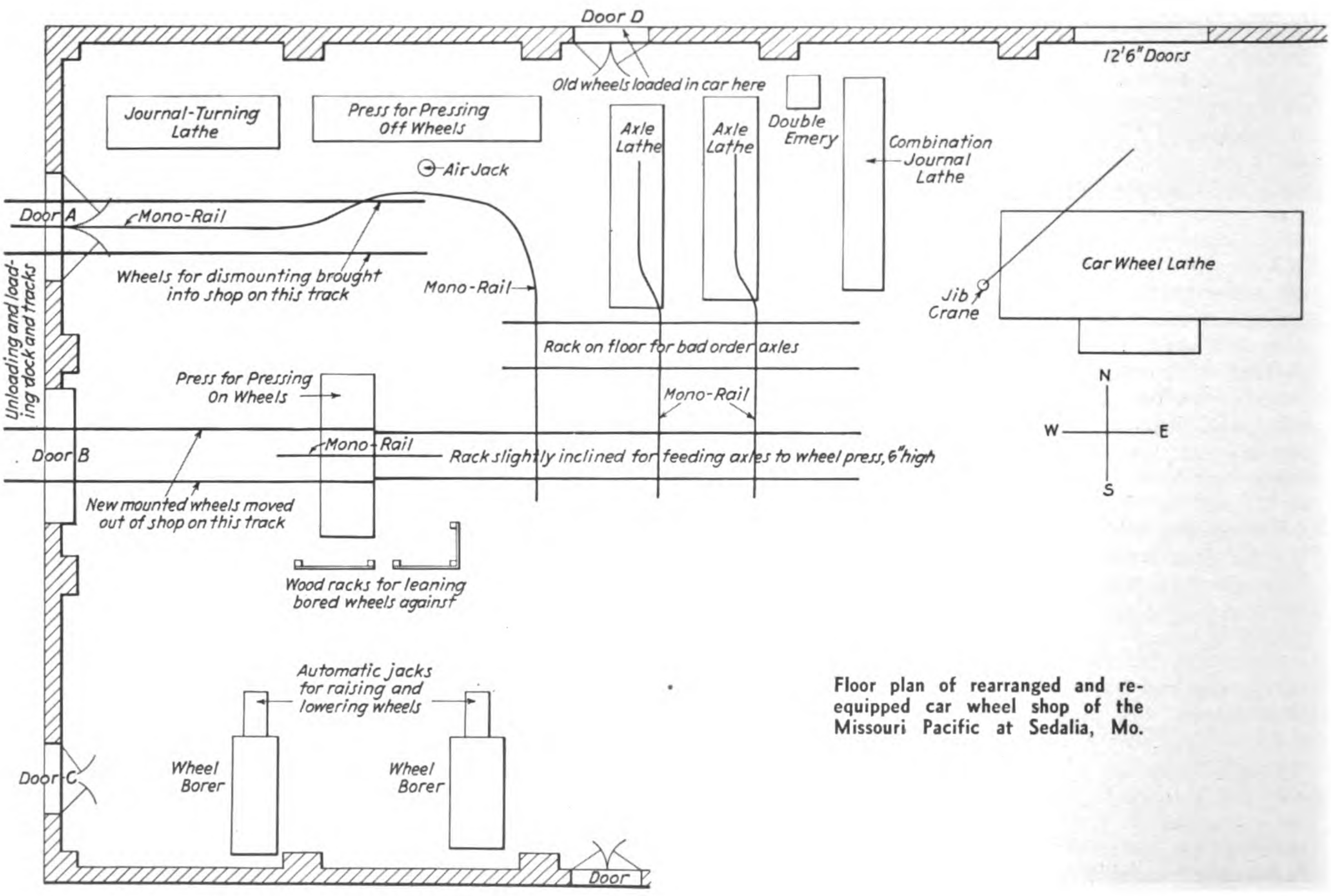
elevator located at door *D* and elevated into a box car outside. The scrap axles move on a mono-rail to a point adjacent to the loading and unloading track; the usable axles to a runway in the center of the shop in front of the mounting press, which will be referred to later.

Usable wheels, amounting to about 15 per cent of those removed, are rolled across the shop to the boring mills and from there handled the same as new wheels as described below:

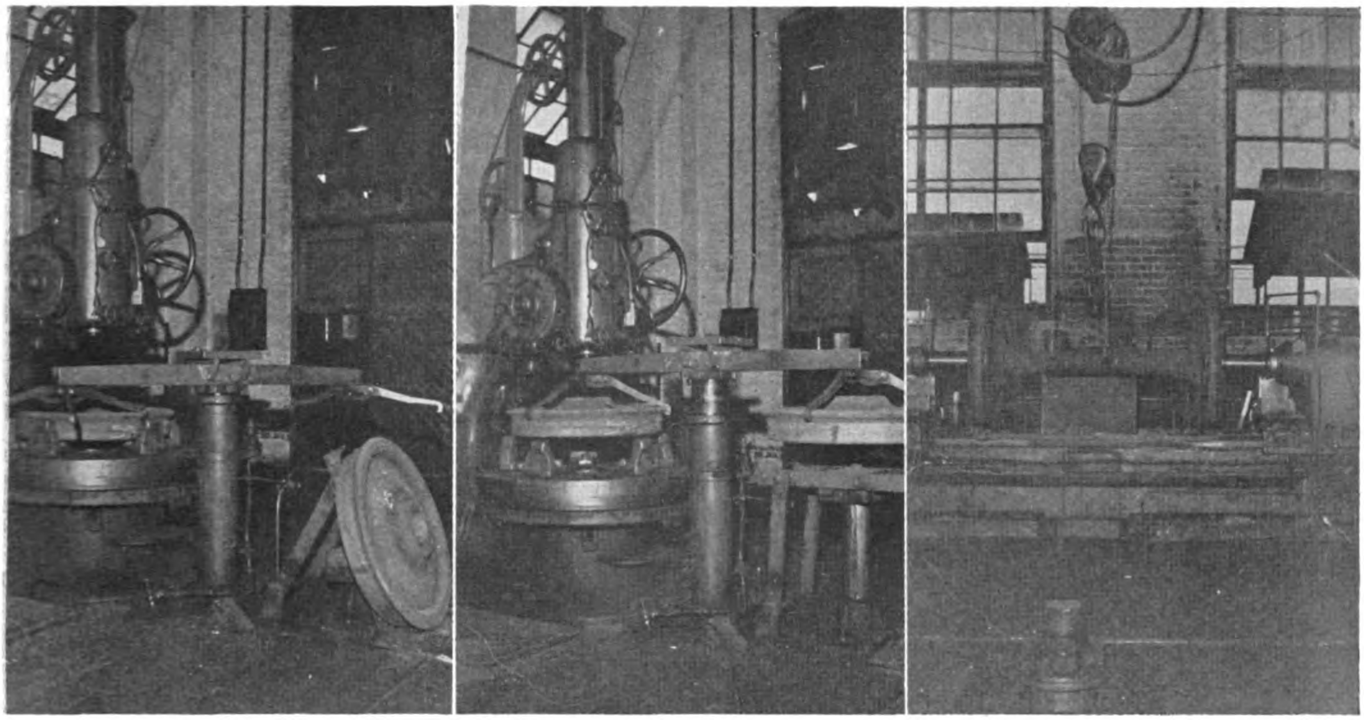
Axles which require work other than journal turning, which is done on a journal lathe as the wheels enter the shop, are placed on racks adjacent to the three axle lathes which are located beyond the dismounting press. New axles are also placed on these racks, all being handled with mono-rail hoists. New and old axles after being handled on the axle lathes are placed on the runway in the center of the shop leading to the mounting press.

The finished-axle runway inclines to the back of the mounting press so that the axles roll by gravity to the press. There is a retaining device at the end of the runway arranged so one axle can be placed in position for mounting on wheels, a small air jack below the center of the axle raising it to the proper height.

New wheels, unloaded from cars just outside the door *C*, are placed on edge in rows so a small lift truck with a single projecting bar, small enough to enter the center holes, can pick up and deliver three wheels at a load. These wheels are placed on edge adjacent to a Powell pneumatic lifting device, at each of the two boring mills. These mills are located along the south wall of the shop.



Floor plan of rearranged and re-equipped car wheel shop of the Missouri Pacific at Sedalia, Mo.



Boring mill with Powell air lift—Journal lathe equipped with Hagen friction end drive

The pneumatic lift removes and loads in one lift. The top cross arm with a suitable automatic clamp picks up a wheel at each end so that a finished wheel is picked off the machine at the same time a rough-bored wheel is picked off the pneumatically operated stand at the other end. The arm is then raised, turned 180 deg. and the rough-bored wheel lowered onto the table of the machine at the same time that the finished wheel is lowered onto the pneumatic stand. The stand then lowers the finished wheel into position for rolling to the mounting press.

Both the demounting and mounting presses are equipped with pneumatic control valves which enable the operator to work from the center of the press at all times and thus eliminate the loss of operator's time for starting and stopping the ram movements. These control valves are so arranged that the press operator also handles the wheel-mounting and check gage. The wheels are then mounted on the waiting axle, journals painted with a rust-resisting solution and given a slight push which rolls them into position for loading with the traveling crane onto a car which has just been unloaded.

This describes in a general way the movement of the wheels resulting in what might be termed a double U, placed so that one outer stem represents the incoming second-hand mounted wheels and the new axles. The other outer stem is for the incoming new wheels and the center stem for the outward movement of the finished product, the two center stems coinciding.

The Reeder device, again used, requires only three lifts to load an average car. Wherever it is necessary to make right-angle movements, small air lifts are installed below the floor with suitable saddles to engage the axle centers. These jacks are used to raise the wheels off the floor enough so that they can be swung around as desired.

Formerly there were three shops in the territory handling the mounting of both steel and cast-iron wheels. The equipment from the Kansas City shop was moved and installed in the Sedalia shop described above and cast-iron wheels handled exclusively, the steel-wheel work being handled in the St. Louis shop at which point the cast-iron wheel work was also abandoned. This consolidation and concentration of work on cast-iron wheels at Sedalia and steel wheels at St. Louis has resulted in a much more economical and efficient handling of the work.

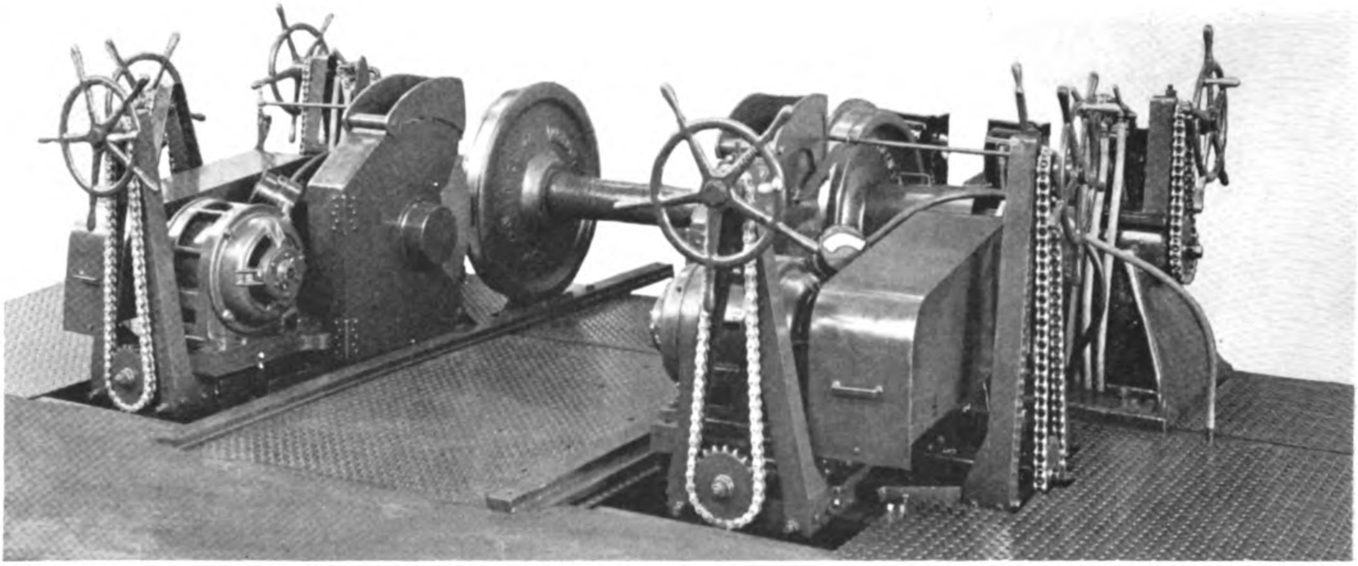
Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Joint Inspection Not Necessary to Justify Bill for Flood Damage to Cars

Eighteen Missouri Pacific cars were located in the flood of January, 1937, on the Baltimore & Ohio. All of these cars were delivered to the M. P. at St. Louis without defect-card protection as required by the rules, except two cars which carried defect cards reading: "Car in flood—home for repairs." Defect cards for the other 16 cars were issued at St. Louis against the B. & O. reading: "Cars entirely submerged in flood waters," or "Cars in flood waters to a certain height," and "Home for repairs." The defect cards did not show any specific items of damage to the cars. Bills were rendered to the B. & O. covering the cost of repairs due to the flood damage. The B. & O. contended that a blanket defect card should not be authority for the car owner to render bill for extensive repairs without obtaining joint inspection certificate in accordance with Rule 4, Section (k), or giving the carding line an opportunity to inspect the cars. The M. P. contended that flood damage is a handling-line responsibility as defined in Rule 32, Section (1), and

(Continued on page 329)



Operator's side of the new A. C. F. car wheel grinding machine

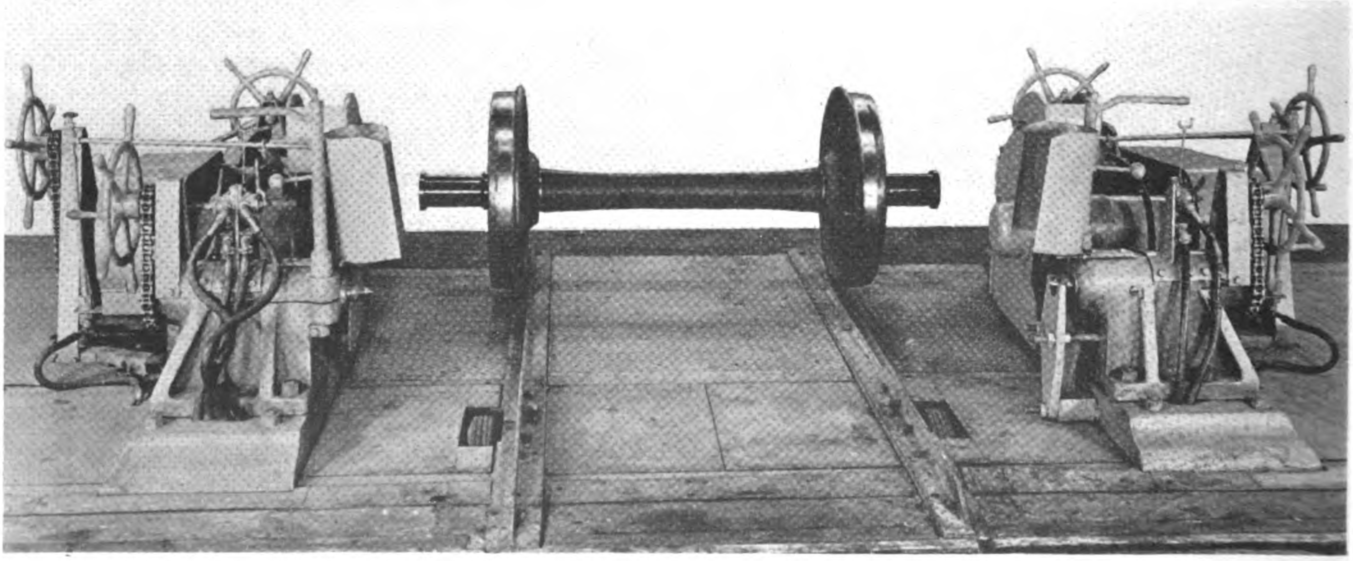
Wheel Grinder Operates On New Principle

About three years ago, the American Car and Foundry Company, New York equipped its plants with car-wheel grinding machines of its own design and established the practice of grinding mounted wheels in pairs for application in all new cars built by the company and on most orders furnished under wheel-and-axle mounting contracts. The results obtained on over 215,000 wheels has been such as to influence the company to place this machine on the market. The requirements upon which the company based the design of the machine are that it produce a mounted pair of wheels the treads of which are of identical circumference, concentric with the journal and presenting a perfectly smooth surface for rail contact, and that the operations be performed at low cost and with a minimum loss of tread wearing material. An important advantage is that it affords a means of checking the preceding fabricating operations such as molding, boring, mating and mounting. Imperfect work is immediately reflected as soon as the mounted wheels are revolved in the grinder and contact made by the abrasive wheels.

The new A. C. F. car-wheel grinder was designed specifically as a production tool for wheel-and-axle shops to accommodate shop tool arrangements where the grinder is in the line of operation between mounting press and truck assembly track or where the grinder may be installed against the wall of the shop.

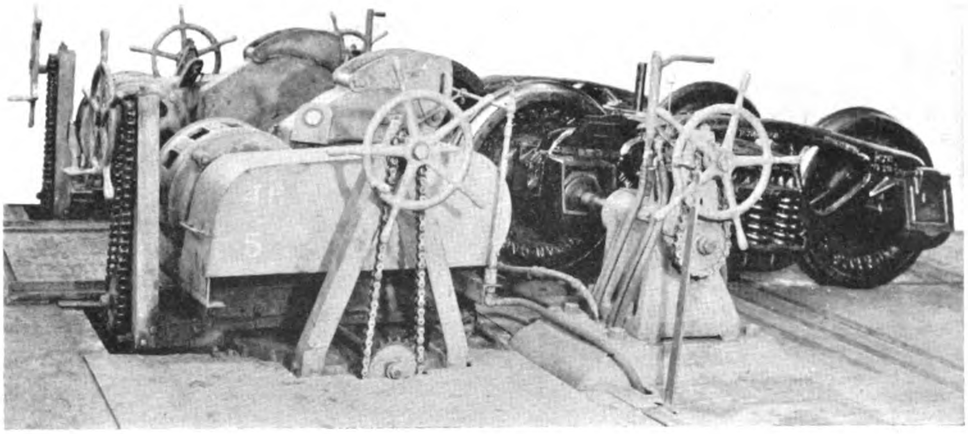
The bedplate is built up of heavy rolled-steel sections, forming a base on which the tailstocks are mounted. The mounted pair of wheels is rotated by friction drive and ground on centers carried by the tailstocks. The abrasive wheel housings and driving motors are mounted on heavy bracket extensions which form part of the bedplate.

The tailstocks are of cast iron adjustably mounted on flat ways forming the top of the bedplate. The tailstock



The rear of the machine showing the pneumatic-tired drivers in the floor

A side view of the grinder with a freight car truck mounted in the machine for the grinding of one pair of wheels



spindles are of large size, are rotatable and secured in any angular position by means of clamp bolts. The centers are eccentrically located in the spindle, the throw determining the distance from the friction drive wheel to the center of the spindle, thus accommodating a range of car-wheel diameters from 28 in. to 37 in.

A friction drive is employed for rotating the pair of mounted wheels when being ground, which consists of two pneumatic-tired wheels making driving contact with the treads of the car wheels being ground. This work drive consists of a longitudinal shaft located in the bedplate below the tailstocks and parallel with the tailstock centers. On this shaft are mounted the two pneumatic rubber-tired wheels. This shaft is driven by a geared motor directly connected to one end of the shaft. The rubber-tired wheels are elevated into driving position or lowered when work is being rolled in or out by means of a small air cylinder adjacent to each wheel. The use of this type of drive permits grinding the treads of mounted wheel pairs without the removal of roller-bearing journal boxes.

Two independent driving heads for abrasive wheels are adjustably mounted on the bracket extensions of the bedplate. The driving heads are mounted on the bedplate with the abrasive wheel spindles parallel to the taper treads of the car wheels and each abrasive wheel is fed against the work by means of a hand-operated feed screw. Each abrasive wheel is mounted on a roller-bearing spindle and is rotated by means of a multiple V-belt drive from a motor secured on top of the cross-slide table. Adjustment is provided for the angle of the face of the abrasive wheel to enable the operator to grind wheels with either cylindrical or taper treads.

The bracket extensions to the bedplate have ways planed on top parallel with the bedplate, on which a large table is fitted. In the top of this table ways are planed at right angles to the abrasive wheel spindle and a second table or cross-slide is fitted thereon. The abrasive wheel and motor assembly is bolted on the cross-slide and may be fed against the work or backed off by means of a hand-operated feed-screw. Provision is also made for manual feed of the abrasive wheel across the face of the work. The entire abrasive wheel and motor-drive assemblies are retractable from the working position away from the transverse center line of the machine; movement parallel with the center line of the bed from the operating position to a position toward the ends of the machine is effected by means of air cylinders the piston rods of which are directly connected to the table above described.

The characteristic of retractable grinding heads, permitting the rolling of mounted pairs of wheels through the grinder on the running track in a continuous direction is unique in this machine and has proved practical. It also permits grinding wheels without removing them from freight trucks.

The A. C. F. grinder is designed for alternating-current motor equipment but modifications can be made for direct current if desired. The motor equipment of the standard machine consists of two 25-hp., three-phase, 60-cycle 220/440-volt motors on the abrasive-wheel drive, operating at 1,800 r. p. m. and one 4-hp. general purpose enclosed-gear motor which operates at 37.5 r. p. m. This latter motor is on the work drive.

The A. C. F. grinder occupies floor space 10 ft. by 24 ft. and weighs 24,000 lb. in working order. Two 30-in. by 2½-in. by 12-in. abrasive wheels are furnished as standard equipment. The machine is designed to grind the treads of wheels mounted to 4-ft. 8½-in. gage but can be built for narrow-gage work.

Experience with this machine has indicated that the average floor-to-floor grinding time for new chilled-tread wheels is from 3 to 4 min.; two men are required to perform the grinding operations.

The advantages claimed for ground wheel pairs of identical circumferences, and having perfectly smooth treads, concentric with the journals, are: reduction in required tractive force; increase in wheel mileage; elimination of noise; reduction in vibration with resultant lowering of maintenance cost of truck and brake parts and reduction in losses due to breakage of fragile lading.

Draft Gear Maintenance And Claim Prevention*

As is the case with all parts of the cars, draft gears become defective from breakage or from excessive wear, and because the efficiency of the draft gears is dependent upon their proper maintenance, it is very important to have a definite program for maintenance.

In 1927, the Chicago, Milwaukee, St. Paul & Pacific inaugurated a program for periodical inspection of draft gears and repairs if necessary. Because all freight cars

* Abstract of a paper presented by F. A. Shoulty, assistant superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, at the forty-seventh annual meeting of the A. A. R. Freight Claim Division, held May 23 to 25, inclusive, at St. Louis, Mo.

must have the journal boxes repacked and air brakes cleaned, oiled and tested, and cars reweighed and restencilled periodically, under the Association of American Railroads Rules of Interchange, it was deemed an opportune time to examine the draft gears and couplers as well, therefore a definite program was adopted and put into practice whereby draft gears and couplers are minutely examined under certain definite instructions covering system cars.

The coupler is pulled forward as far as possible and pushed back again, this process being repeated several times so that the repair man, who is a specialist on draft-gear repairs, may note whether the draft gear is in need of renewal of some part. If there are no indications that the gear requires repairs, the gear is not taken down, but if there are indications that the gear requires repairs, it is removed from the car and given necessary repairs and renewal of parts. The car is then stencilled, just above the coupler, to show that the draft gear has been inspected and the date and station at which inspection was made is also shown. A record of the test is made and a copy of such record for each car is forwarded to the office of the superintendent of car department, where it is recorded and filed. I might add that whenever a car is shopped for general repairs, which on the Milwaukee is approximately every four years, the draft gears must be removed from the car despite their appearance from outward inspection. The gears are then examined minutely and repaired or replaced.

At the time that draft gears are inspected, both periodically and at the time of general repairs of the car, loose or broken coupler-pocket rivets and cracked and excessively worn coupler pockets are repaired or replaced. Particular attention is given to the back filler in riveted yokes, and where found to be loose or missing, they are replaced. The riveting of the filler in the yoke is not permitted unless the hole is properly countersunk. Coupler keys having the old hairpin cotters are removed, a new hole is drilled and a T-head pin is applied.

Excessive slack in draft gears is corrected at the time of draft-gear inspection. Excessive slack may be determined by drawing the coupler forward and sledging it solid so as to remove all movement of the draft gear. When this is done, if the distance between coupler horn and striking casting exceeds 4½ in., necessary renewal of parts must be made so that this distance be as close to 3 in. as is possible but not exceeding 4 in.

While draft gears and couplers with component parts have been improved a great deal in the past, much still remains in the way of further improvement. Next to wheels, draft gears and couplers are the greatest source of expense in car maintenance and no effort should be spared to improve these parts.

Defective Gears Reduced from 15.6 to 4.6 Per Cent

When we started our periodic inspection of draft gears in 1927, 15.6 per cent of the gears were found to be defective to the point where certain parts had to be renewed. During the year 1938, only 4.6 per cent of the gears inspected were found defective to such extent. In 1928 we spent $338,000 for couplers and coupler parts, while in 1938 we spent only $96,000 for couplers and coupler parts. It must be considered that these savings were accomplished despite the fact that the gears are attached to steel sills which provide no elements for absorption of any of the shocks as was present in the old wooden sills. It is, therefore, obvious that the reduction in defective draft gears and the reduction in failures of couplers and their parts has been due to the greater efficiency of the cushioning effect of the maintained draft gears, and this greater cushioning effect must necessarily have some effect in reducing damage to lading. We do know that our freight-damage bill has been considerably reduced during the past 11 years, but just what portion of this reduction is directly attributable to better-maintained draft gears is not obtainable from the records.

It would be very helpful to individual railroads if the A. A. R. would classify draft gears according to the results obtained in official tests. A good many do not consider that 25,000,000 ft. lb. is sufficient to determine the life and merits of a draft gear. This limit may be satisfactory as a minimum but it is a known fact that some draft gears will stand several times more than the 25,000,000 ft. lb. requirement, while other draft gears which just come within the requirement, will be certified as meeting A. A. R. requirements. If draft gears could be purchased on the basis of quality instead of uniform price, considerable headway could be made.

Notwithstanding the fact that we have gone through practically ten years of depression, the Milwaukee has continued its draft-gear inspection program and demonstrated that it has proved profitable, from an economic standpoint, not to curtail the maintenance budget to the extent of sacrificing draft-gear inspection, when economies must be enforced. If all railroads were as conscientious about draft-gear maintenance as they are about cleaning air brakes, repacking journal boxes and reweighing cars, it is my opinion that freight claims would be very substantially reduced, as free-slack in a freight train probably is doing more damage to lading than anything else.

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

472—*Q.—Name the operating positions of the D-22 valve.* A.—The release, preliminary quick service, service, service lap, graduated release lap, emergency, and accelerated emergency release.

473—*Q.—What communications are open in the release position?* A.—Between the brake pipe and the auxiliary reservoir as follows: Brake pipe to face of the service piston, through the feed groove in the service piston bushing to the service slide valve chamber, to release the piston chamber, and from there through passage to the auxiliary reservoir.

Between the brake pipe and the emergency reservoir as follows: Through the charging port *X*, in the service piston bushing past the ball check valve *85* and the flat check valve *73*, through choke *81*, and through passage *2d* and pipe *2*, to the emergency reservoir. [Note—Letters and figures refer to instruction pamphlet diagrams—Editor]

Between the brake pipe and the supply reservoir as follows: Through passage *s* and choke *83* to limiting valve chamber *H*, past check valve *147* to passages past the ball check valve *85a*, and flat check valve *73a*, to the chamber above check valve *74* and *87*, thence through passages and pipe *6* to the supply reservoir.

Between the brake pipe and chamber *F* on release insuring diaphragm. Between the brake pipe in chamber *B* on the face of the emergency piston and the quick-action chamber via charging choke *27* to chamber *E* on the slide valve side of the piston and a passage.

Between the service slide valve chamber, auxiliary reservoir pressure, and the release slide valve chamber.

Between the service slide valve chamber and the spring

side of the release piston (chamber E) by way of the port in the service slide valve and passage in its seat.

Between the auxiliary reservoir and the supply reservoir as follows: From chamber D through the port in the release valve and the passage in its seat past ball check *74* and flat check valve *87* to the passage leading to pipe *6*, to the supply reservoir.

Between the displacement reservoir and exhaust by way of the cavity in the release slide valve and the exhaust passage in its seat.

Between the emergency reservoir to the under side of the emergency slide valve and between the emergency reservoir and the small diaphragm area on the upper side of the cover gasket exerting downward pressure through the strut to keep the emergency slide valve seated when there is no pressure above the slide valve.

Between the emergency reservoir and the spring chamber above the spill over check valve.

Between the emergency reservoir and both the outer face and the spring side of the emergency valve.

Between the under side of the ball check *51* (through a choke passage) and emergency slide valve chamber E and the quick action chamber.

474—*Q.—What communications are open in the preliminary quick-service position?* A.—The brake pipe to atmosphere by way of the service graduating and slide valve and communicating ports and passages past the limiting valve to the quick service volume which is permanently connected to the atmosphere.

From the spring side of the release piston to atmosphere (auxiliary reservoir pressure) by way of ports and cavity in the service slide valve to the exhaust port (exhaust).

From the displacement reservoir by way of passages and cavity in the emergency slide valve to the safety valve, and to the face of the emergency valve.

From the quick action chamber by way of a vent port in the graduating valve and the exhaust port in the slide valve to atmosphere.

From the emergency reservoir to the chamber above the spill-over check valve, emergency slide valve strut diaphragm and under the side of the emergency slide valve.

From the emergency reservoir to the under side of the service slide valve, the chamber over the emergency reservoir check, the spring side of the emergency valve, and the chamber over the emergency reservoir charging check valve.

From the brake pipe to the vent valve chamber, the chamber over the accelerated release check, chamber F in release insuring valve portion, chamber H in quick service limiting valve portion, to displacement reservoir.

From the auxiliary reservoir to the auxiliary reservoir check valve and to release insuring valve portion.

475—*Q.—What communications are open in the service position?* A.—The brake pipe to the displacement reservoir by way of the limiting valve, until the displacement reservoir (which is connected to the chamber over the limiting valve diaphragm) pressure has reached 14 lb. The brake pipe to the vent valve chamber and over the accelerated release check and chamber F in the release insuring valve portion. Auxiliary reservoir to displacement reservoir. Auxiliary reservoir to release insuring valve portion and to auxiliary reservoir check. Displacement reservoir to safety valve, and face of the emergency valve. Emergency reservoir to the spring side of the emergency valve. Emergency reservoir to chamber above spill-over check, valve and chamber over the emergency slide valve strut diaphragm.

Emergency reservoir to the chamber above the emergency reservoir check and chamber over the emergency reservoir charging check valve. Quick-action chamber to atmosphere by way of the emergency graduating valve and slide valve.

476—*Q.—What is the purpose of the accelerated release check valve and ball?* A.—To provide accelerated built up of brake pipe pressure, after an emergency, from the combined volume of auxiliary and displacement reservoir when the slide valve moves to an accelerated release position.

477—*Q.—For what purpose is the diaphragm spring and slide valve strut?* A.—It serves to keep the slide valve seated in the absence of quick action chamber pressure.

Decisions of the Arbitration Committee

(*Continued from page 325*)

that, until the rules are modified to place flood damage under Rule 4, Section (k), there is no infraction of the rules under which these charges were rendered.

In a decision rendered November 17, 1938, the Arbitration Committee stated: "The contention of the Baltimore & Ohio is not sustained."—*Case No. 1,763, Baltimore & Ohio versus Missouri Pacific.*

[NOTE: In the report of the Arbitration Committee presented and accepted at the 1939 A. A. R. Mechanical Division Convention, the committee recommended that a new interpretation be added to Rule 4, to become effective August 1, 1939, which states that in cases where whole or part of superstructure is involved through general statement of damage, car owner must accord railroad issuing the defect card the opportunity of participating in joint inspection. If the railroad issuing such defect card fails to avail itself of the opportunity of making joint inspection within 15 days from date of notification, then the joint inspection shall proceed in the manner prescribed in Section (k). The decision in this case was based on the rules in effect prior to the adoption of the new interpretation.—Editor]

Adjustment of Lading May Involve Removal and Replacement on Same Cars

On September 13, 1935, the Chicago, Rock Island and Pacific delivered two flat cars, one having a single overhanging load of piling and the other being used as an idler, to the St. Louis Southwestern. The car inspector of the St. L. S.-W. recorded that the car had an extreme overhanging load when received by him. At a later date, the C. R. I. & P. furnished the St. L. S.-W. with a car check of the form specified in the A. A. R. rules with the word "transfer" crossed out and intended this form as authority to bill for the expense of adjusting the lading. The St. L. S.-W. unloaded this lading completely and reloaded it as a twin load on the same two cars at another point where facilities were available for handling this work. The C. R. I. & P. contended that the check form which was issued did not authorize the unloading and reloading of the cars as a twin load, and considered this work to be a transfer of lading regardless of the fact that the same two cars were used.

In a decision rendered November 17, 1938, the Arbitration Committee stated: "The contention of the Chicago, Rock Island & Pacific is not sustained."—*Case No. 1,764, St. Louis Southwestern versus Chicago, Rock Island & Pacific.*

IN THE BACK SHOP AND ENGINEHOUSE

There's Always A Way

By Walt Wyre

The job of being a mechanic around a railroad is one that requires, above all else, the ability to dip into the well of past experience and come up with the solution to the problem of the moment. In this month's story Walt Wyre is taking us on a personally conducted tour of the S. P. & W. with Henry Barton, "who does the welding at the Plainville roundhouse." The leaky fuel tank of the 5091 calls for a neat job of designing in addition to the welding. The fire-door hole on the old locomotive boiler at Middleton requires another brand of ingenuity including holding at bay a too-helpful helper and, that the day might not be too dull, Evans wanted "to get your idea on building a furnace for annealing drawbars." Being a railroad mechanic, he had his say—"but I'll think about the furnace." By now it is probably finished.

ROUNDHOUSE foremen are always hopeful of getting one more trip out of a locomotive before tying it up for repairs. Jim Evans is no exception. He knew that the fuel oil tank on the 5091 was leaking. It had been reported the last three trips and oil leaks have a habit of getting worse instead of better. Evans did figure he could get one more trip out of the engine before repairing the leaking tank. When he looked at the tank he changed his mind and revised his engine lineup for the day and went in search of Henry Barton that does the welding at the Plainville roundhouse.

"Seems like we are having a lot of trouble with fuel oil tanks leaking," Evans told Barton.

"That's right," Barton admitted, "we are. There's a lot of weight on the bottom of the oil tanks and even if they are blocked in good and solid, they're bound to do a lot of working."

"We've had this tank out three or four times in the last six months, and some of the others are almost as bad." Evans turned to go to the office. "When you get this one out, see if you can't figure some way to repair it so it will last a while."

"I've been thinking about that," Barton said, "and believe I have a plan worked out, if we can get the time."

"How long will it take?" the foreman asked.

"About three or four days," the boilermaker said, "if we don't have too much other work."

"I'll tell the hostler to spot the engine and drain the oil out. When you get the tank lifted up we'll look at it and talk about your idea for repairing it. I'm afraid we can't tie the engine up that long," Evans said.

When the S. P. & W. changed from coal to oil, the fuel oil tanks were designed to fit in the space formerly used for coal. The oil tanks, as a result, are built with sides and back that flare out to fit the slope of the coal space. This makes the bottom of the tank small as compared with the top.

In order to keep the weight down as much as possible, the tanks were built of quarter-inch tank steel. Several years' service showed that the bottoms should have been heavier, but flanging and fitting a new bottom is a job that calls for more equipment than is usually found at a roundhouse.

The oil tank of the 5091 was drained and flushed out. Then the tank was spotted under the derrick and the tank hoisted up. Barton was measuring the space where the tank fitted when the foreman came out to see how much of a job it was going to be to repair the leak.

"What do you think?" Evans asked. "Is it much of a job to fix it?"

"Oh, I can chip the crack out and weld it in a little while, but it'll be leaking again after a couple of trips. We might as well fix it right while we've got it out."

"But the 5091 is a good engine," Evans protested, "and I can't tie it up three or four days. Couldn't you get it done sooner?"

"Afraid not," Barton replied. "But why don't you use the tank off the 5087? It'll be two weeks before she will be off the drop-pit, won't it?"

"That's right"—Evans pulled out his plug of "horseshoe"—"I'll have the painter change the numbers on the tank."

"Guess I've stuck my neck out again," Barton said to his helper. "But it's a good idea if it works."

"What are you going to do?" the helper wanted to know.

"The first thing," Barton replied, "is to get this oil tank on the ground and bottom up. The next is to get that sheet of ⅜-inch steel I've got stacked away behind the steel rack."

"I wondered what your idea was hiding that steel," the helper said.

The bottom of the oil tank had been repaired many times. Most of the breaks had been along the seam where the bottom was welded to the sides; evidently caused by vibration.

"What are you going to need?" Barton's helper asked.

"The first thing is a cutting torch."

It didn't take long to cut the bottom out of the tank. Forming the new one of ⅜-inch steel by hand did take considerable time. When finished, the bottom of the tank resembled a rectangular bucket lid with a ⅜-inch flange.

"Say," the helper exclaimed when they were putting the finishing touches on the tank bottom, "haven't you got it too big to fit inside the tank?"

"It's not going to fit inside," Barton replied. "It's going to fit over the outside."

It required a little heating and hammering to make the heavy steel bottom fit the sides of the tank snugly, but it was done, and it was ready for the seam to be welded.

"That ought to hold it," helper remarked when Barton lifted his welding shield and laid down the electrode holder.

"It will when I get through," Barton said. "I'm going to weld a sheet of quarter-inch steel on the sides up to where the flare starts. That will stiffen it and keep it from breaking at the seams."

"Well, it looks like a good job," Evans remarked when the tank was ready to go back in place. "Wish we had time to fix them all like that," he added.

"I thought we might get started on the 5092 right away," Barton said. "It's in pretty bad shape."

"Too much other work right now," Evans replied, "and by the way, you've got to go to Middleton in the morning to repair a stationary boiler. I don't know just what there is to be done. Better get your tools together this afternoon."

MIDDLETON was once an important point on the S. P. & W. That was before they started running trains through. Now about all that is left of the roundhouse and shops is a dilapidated turntable with a lot of vacant space around it. There is not even any compressed air to operate the motor that was used to turn the table.

There is an office that looks like it was left standing because the warped and weathered boards weren't worth saving. The only buildings that have been kept in presentable repair are the pump houses and stationary plant. The latter supplies steam for heating fuel oil and operating water and oil pumps.

"Better take everything with you that you are likely to need," Evans told the boilermaker. "You won't find anything in Middleton."

Barton took the foreman at his word and filled a huge box with tools. He and his helper hauled the tool box to the station that afternoon. He and the heavy tool box both left next morning on the same train.

When Barton found that the boiler house was nearly a mile from the passenger station, he went to the little office building in hopes of getting help to handle the heavy tool box. There was no one around. He went on up to the boiler house.

A switch engine was standing beside the house. A fireman was sitting in the cab nodding drowsily. "Say," Barton yelled to be heard over the noise of the locomotive blower, "I've got to have some help to get my tools over here."

The fireman leaned out the cab window. "Help is one thing you won't find around this place."

"How am I going to get my tools over here?" Barton was beginning to wish he had brought his helper with him.

"There's a wheelbarrow in the stationary house," the fireman replied.

Shoving a heavily loaded Irish buggy over a hard surface is work, and the path from the station platform to the boiler house is far from being a cement walk. Besides loose gravel and soft dirt there are half a dozen tracks to cross and no crossings.

Sweating, swearing, and shoving, Barton finally made it just as the fireman blew the locomotive whistle for twelve o'clock noon.

Before going back to work after lunch, Barton went by the telegraph office. There was a wire wanting to know how he was getting along with repairing the boiler and when it would be ready to put back in service. It was from the division engineer.

"What will I tell him?" the operator asked.

"Tell him," Barton replied, "they had better send an engine up to relieve the one being used for steam. From the way it looks now the one they are using will be due for an annual inspection before this job is finished. I haven't even had a chance to look at the job yet."

"I'll tell the division engineer you'll wire later," the operator said.

"O. K." Barton turned and headed for the boiler house. He was prepared for the worst when he looked at the boiler and that's what he found.

The boiler was an old style locomotive type. Rusty streaks around the fire door ring showed where at least part of the repairs were needed. Further inspection showed no other serious leaks. A few flues would need a little caulking. Several places in the side walls could be repaired the same way, although chipping out and welding would be much better.

Barton started first on the big job. He got caulking chisels and hammer to see how that would work. The third blow drove the caulking chisel through the rusted edge where the boiler shell joined the fire door ring.

"It's in kinda bad shape." The fireman had come into the boiler house to watch.

"Yes," Barton replied. "It'll take more than caulking to repair that. It's all rusted out."

"What are you going to do about it," the fireman asked.

"Is there any place an electric welder can be hooked up?"

"There are some wires right outside the building." The fireman pointed with his thumb. "I guess one could be connected to them."

"Well, I'm going to wire the master mechanic at Plainville to send an electric welder and an electrician. Wish I had a bicycle," Barton added as he started back to the station. He also asked that a fire door frame for a 700 Class engine be sent.

The next thing needed was a cutting torch. For a wonder, there was an outfit in the water service shop.

While the fireman watched, Barton worked. He slid into the damp fire box and started on the inside shell cutting around the fire door ring. When that was finished, he did the same on the outside shell which left a rectangular opening where the fire door had been.

"Got a piece of string?" he asked the fireman.

"Going to try to tie them two edges of the boiler shells together?" the fireman inquired jokingly.

"No," Barton replied. "Going to hitch that bull of yours outside. Didn't you ever hear of laying out an ellipse with three pins and a string?"

The string was found. Barton measured and made a mark on either side of the opening and then one above to mark the edges of the oval opening.

"Now what?" the fireman asked.

"Here, I'll show you. Hold the end of the string on that mark on the left. Now bring it over my finger." Barton placed the index finger of his left hand on the mark over the opening. "And," Barton continued, "bring the string to the mark on the right of the door and hold it."

When that was done, Barton removed his finger and using a piece of soapstone in the loop of the string, traced the opening as he had learned years before.

When the opening was cut out, Barton set to work heating and hammering to force the two edges of the boiler shell together.

By the end of the second day, Barton was ready for the welder. The two edges of the outside and inside shell of the boiler had been brought together and V'd

out, but the welder had not arrived. The morning of the third day there was a message that the welder and an electrician would arrive together that morning.

It was a bigger job to get the welding machine to the boiler house than it had been to get Barton's tool box over, but there was more help. The machine was loaded on a baggage truck and hauled over.

Ned Sparks, the electrician, had brought along an assortment of wires to be used connecting the machine.

"How long will it take to get the welder going?" Barton asked.

"Not very long if"—Sparks was looking at the wires overhead—"if that is a three-phase circuit, which I doubt."

It wasn't. The circuit was for lights and the welder motor would not run on it. The rest of the afternoon was spent by the electrician trying to figure out some way of getting the welder going. Barton chipped out two or three small cracks in the fire box. He used air from the locomotive reservoir to operate the air gun.

By five o'clock the electrician was ready to give up. He had figured every way he could think of to get the proper current to the welder, but there wasn't any practical way it could be done.

"What are you going to do about it?" Sparks asked Barton.

"Huh!" the boilermaker snorted. "I'm not an electrician! You get the welder going and I'll do the work."

By this time the wires between Plainville and Middleton were beginning to droop with the heat of messages wanting to know why the delay getting the boiler going. The superintendent had gotten in on it and was urging the master mechanic. The trainmaster was raising thunder about needing the switch engine that was furnishing steam.

"It looks," said Barton, "as if things had come to an impasse, whatever that is."

"If it means a helluva mess," Barton said, "things have come to it. But we've got to figure out something."

"I've got a good notion to catch the Limited tonight and go back to Plainville," the electrician said.

"There'll be two of us if you do," Barton said. "Maybe you can figure out something in the morning."

Next morning the electrician went up town. Barton set to work drilling and tapping holes in the boiler to fasten the fire door frame. It was slow, tedious work drilling the holes with an air motor even with the pumper helping. He had obtained authority to use the pumper who turned out to be a fairly intelligent helper.

It was almost noon when the drilling and tapping was finished and no signs of the electrician. The electric welder was still standing on the baggage truck by the side of the pump house.

Barton sat down in the boiler house door to rest a moment and take a smoke when he saw a ramshackle truck approaching. As the truck drew nearer he recognized the electrician sitting beside the driver. The truck pulled up and stopped about a hundred and fifty feet from the boiler house. Barton walked over to investigate.

"Did you finally figure out a way to get the welder going?" Barton asked.

Sparks slid from the truck. "Do you know anything about welding with alternating current?"

"Never tried it," Barton said, "but guess I could if I had to. Is that an a. c. welder? What have you got two for?"

"Those are transformers," the electrician said. "When I get through connecting them up you'll be able to weld with them—I hope."

The driver of the truck was a mechanic that operated a garage and general repair shop in town. He and Barton helped the electrician string out the wires.

When it was finished, two wires from a line about three hundred feet away were connected to one of the transformers and the two transformers were connected together. The leads from the welding machine were removed and connected to the transformers.

Barton tried welding first on a piece of steel he picked up. The metal sputtered and spattered like chicken livers in hot grease.

"Say, I can't weld with that arc. It's wild as the division engineer will be when he gets my wire telling him the job is blowed up."

The electrician scratched his head thoughtfully and said nothing.

"Say!" Barton exclaimed, "I'm no electrician, but maybe if you run the current through the reactor coil on the welder it would help."

"I believe you've got something," Sparks said.

When the electrode wire was cut and the ends connected to the reactor, Barton tried again. After two or three attempts he held a fairly steady arc.

"What do you think?" Sparks asked anxiously.

"Well," Barton replied, "I don't know what the job will look like, but guess I can make it. I couldn't if I wasn't using heavy coated welding wire, though."

The job was finished and didn't look so bad either.

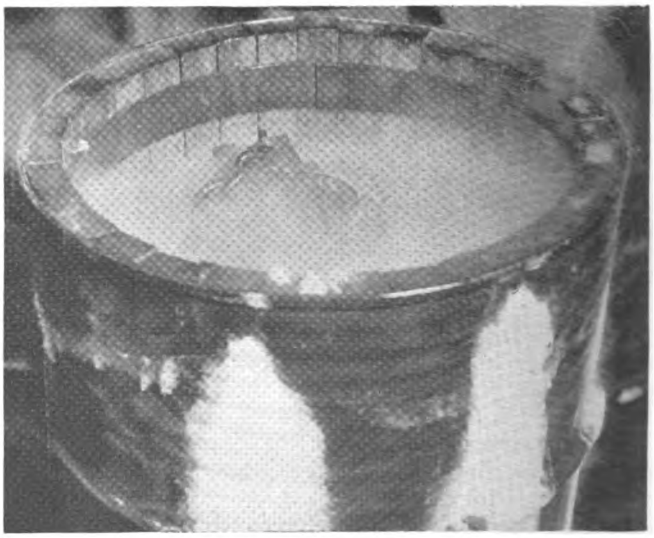
A FEW days later Evans sent for Barton to come to the roundhouse office. "I wanted to get your idea on building a furnace for annealing drawbars," Evans said.

Barton stood a moment thinking, then replied, "From here on out I'm practicing birth control on ideas, at least until I get over the effects of having the last two—but I'll think about the furnace."

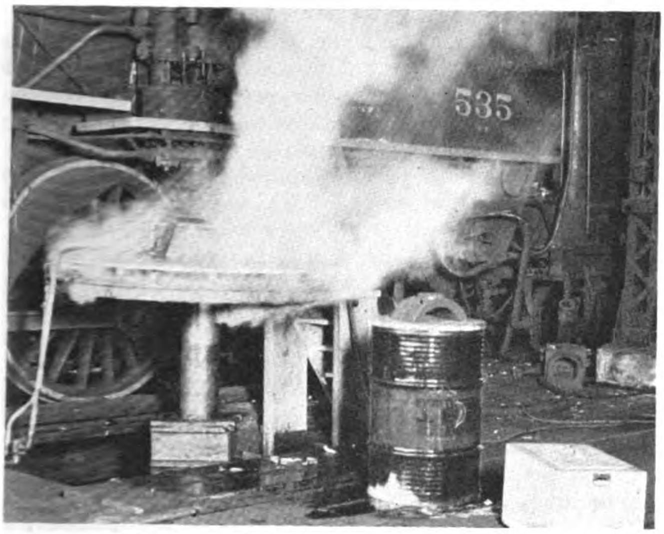
Method of Shrinking Locomotive Parts

By R. T. Peabody

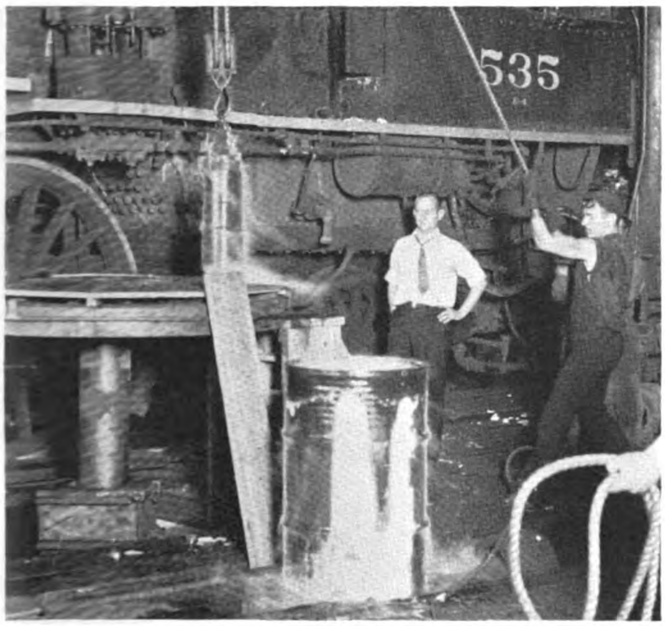
Within a single generation, the size of locomotives has increased until they have become giants, massive and heavy. Many parts have doubled and even tripled in size and weight. But, so far as tolerance fit is concerned, American engineers and designers have reached the



The crank pin being "frozen" in the solution

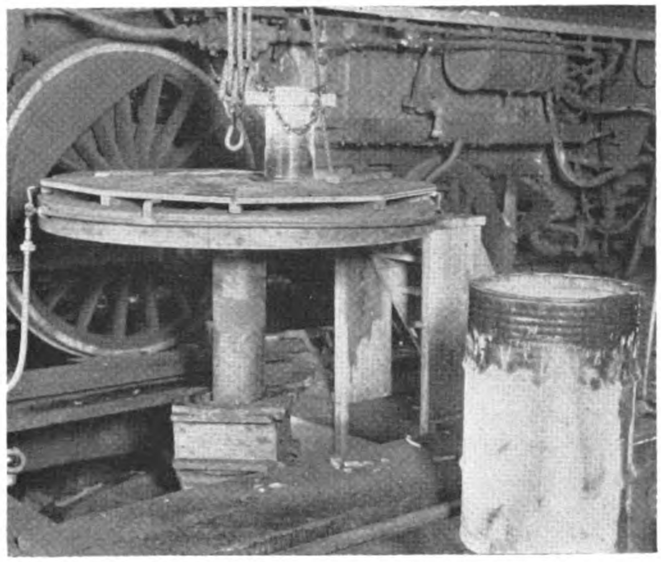


Above—Heating wheel center to 180 deg. F. with steam. Below—Lifting the pin from the cooling bath to the wheel



limit in size and weight of such parts as crank pins, wrist pins, truck wheels and axles, truck boxes, driving boxes, driving wheels, etc., fitted together under hydraulic pressure with a slight oversize tolerance, in some cases .001 in. per inch of diameter, in some cases less than that.

Ever since successfully applying brake-hanger bushings with liquid air on the Boston & Albany in 1929, the author has been working on a better method than



The cold pin being inserted in the wheel center

Tolerances Needed for Dryal Fits

PASSENGER-COACH TRUCK-FRAME BUSHINGS

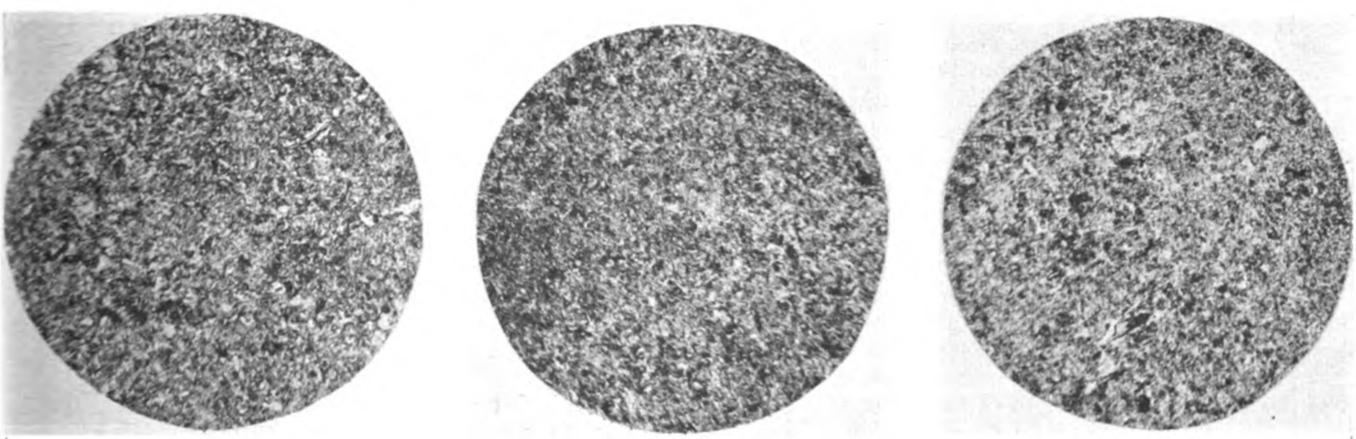
Diam., in.	Tolerances, in.	Length, in.	No. per truck
1⅞	0.002	1⅛	24
3¹/₁₆	0.003	1⁷/₁₆	8

LOCOMOTIVE TENDER-FRAME BUSHINGS

Diam., in.	Tolerances, in.	Length, in.	No. per frame
6⅛	0.006	3	4

GENERAL PURPOSE BUSHINGS

Diameter, in.	Length, in.	Proposed Tolerance, in.
1⅛	1⅛	.001
2¼	2	.002
2⅝	3½	.0023
2⅝	4	.0023
2¾	1¹⁵/₁₆	.0025
2¾	2	.0025
3	2¼	.0027
3	2³/₁₆	.0027
3¹/₁₆	1⁷/₁₆	.0028
6⅛	6⅜	.005
6½	4	.005
7	4	.0065
7⅛	4	.006
7⅛	5⅛	.006



Micro-photographs of a piece of carbon vanadium steel. At the left is the grain structure of the original steel; the center photo shows the grain after cooling to minus 60 deg. F. and quenching in oil at 180 deg. F. The photo at the right shows the grain after cooling to minus 60 deg. F. and allowing the steel to warm up to room temperature. Specimens were polished and etched with 2 per cent nitric-alcohol solution. Magnification 100 times.

hydraulic pressure for heavy locomotive parts requiring tolerance fits, and has developed a method which has been designated Dryal.

On March 30, 1939, a demonstration was made which indicated that through the use of this method locomotives can now be built with almost perfect tolerance fits.

Description of Test

A mounted scrap disc main driving-wheel center was prepared. A crank pin was immersed in a dry-ice and alcohol solution for 30 min. which reduced the pin temperature to minus 60 deg. F., and, while the pin was in the solution, the entire wheel center was heated with live steam to 180 deg. F., so that it expanded evenly. Before cooling the pin and heating the wheel the pin diameter was 9.341 in. and the wheel bore 9.331 in., indicating a shrinkage tolerance of 0.010 in.

After the pin had been chilled in the solution, it was lifted by an overhead crane, transferred to the wheel center, and slipped gently into proper position in the hole *of its own weight* with plenty of space to spare.

The pin dropped into place without any hammering or pressure and without any friction. A pressure of 275 tons was required to remove the pin, or 75 tons more than for pins inserted by the former method.

The pin remained the same, while the bore measured 9.337 in. along the center line and 9.335 in. at 90 deg. straight, proving that in the hole, which was 10 in. deep, there were 10 in. of fit. It is not possible to secure this condition by the hydraulic-press-fit method. The hole was found to be in perfect condition, the micrometer measurements indicating only 0.002 in. out of round.

The pin was tested metallurgically as to the effect of the intense cold on the metal, and the grain structure and physical properties were found to be unaltered.

The Dryal method is economical and is applicable to any locomotive or car part that requires a tolerance fit.

Application of Bushings

Cast iron, steel and bronze locomotive bushings can be applied by the Dryal method. Passenger-car truck frames with various size bushings can be assembled quicker by this method, and the bushings will wear better because of the better fit, if the proper tolerances are used. To obtain the proper Dryal fit, tolerances based on a little less than 0.001 in. per inch of diameter are most important. The accompanying tables show standard tolerances for such fits.

British and French

Staybolts of Monel Metal

By James Clayton, M. B. E., M. I., Mech E.*

It is generally recognized by all locomotive engineers that the measure of the ability of the steam locomotive engine to perform the work required is the capacity of the boiler to produce the steam necessary for the work in hand.

Moreover the part of the boiler which is called upon for maximum output of heat units is the firebox. The inner firebox is perhaps the most arduously treated detail, for on the fireside it is exposed to the effects of the combustion of the burning fuel, urged by the blast of the engine exhaust, while on the water side it must carry the load imposed upon it by the maximum steam pressure generated. Its flat surfaces must be supported at frequent intervals by suitable staybolts fixing it securely and yet with a certain degree of flexibility to the outer casing in such a way that the active circulation of the water is not impeded. Such water-space stays or bolts must be simple in form and easy to apply and renew.

British Practice

In Great Britain the conventional form of copper firebox has been used from the earliest days and still survives here as well as on the continent of Europe. With few exceptions the water-space stays for such fireboxes have also been made of copper.

For many years the Great Western and the Southern Railways have used screwed steel stays ⅝ in. diameter for the same purposes having renewable nuts on the fire side, and screwed steam tight into the outer casing as shown in Fig. 1.

Both railways use these stays made of mild low-carbon steel having a tensile strength of 63,000 lb to 76,000 lb. per sq. in. and with 28 per cent elongation. This material complies with the specification given in the table.

Its chief property is that it is very ductile so as to withstand the bending action to which staybolts are subjected by the expansion under working conditions of the copper firebox plate in relation to the outer steel casing plate. The pitching of these stays is arranged so that they carry each approximately 2,200 lb. of load due to

Specifications of Steel for Firebox Stays

	Per cent
Carbon	0.12 to 0.18
Manganese	0.8 to 0.9
Silicon below	0.3
Sulphur below	0.07
Phosphorous below	0.07
Physical test:	
Tensile	63,000-76,000 lb per sq. in.
Elongation	28 per cent
Brinell	149 (not greater)
Izod	60 ft. lb.

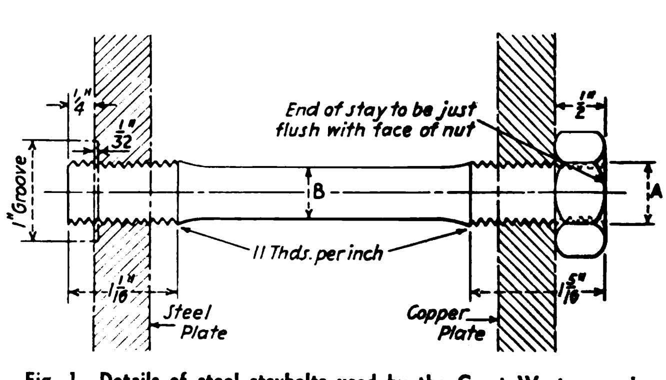


Fig. 1—Details of steel staybolts used by the Great Western and Southern railways

* Vice-president, Institution of Locomotive Engineers; past president, Locomotive & Carriage Institution, and formerly with the Southern Railway Co., Ltd., England.

the steam pressure, thus providing a good factor of safety.

Owing to the impurities in the water used, among them magnesium chloride, and the electrolytic action set up by the dissimilar metals of copper and steel, severe corrosion at the neck of the stay adjacent to the copper plate is often accentuated and cannot be located from the outside. Typical stays removed after service are shown in Fig. 2.

The usual method of detection of broken stays by tapping the firebox end of the stay with a light hammer, which is quite effective when a copper stay is broken, is of no use whatever to detect a stay well reduced in section as shown by corrosion as it would still respond as sound when tapped.

This trouble of corrosion was a very real one as encountered by the Southern and threatened the use of the small water-space stay until the advent of the use of Monel metal for the purpose. This Monel is of high tensile strength with good elongation and ductility to resist fatigue, as will be noted from the table, and is highly resistant to corrosion thus making it an ideal

Typical Physical Properties of Monel Staybolts on the Southern Railway, England

Maximum tensile strength, lb. per sq. in.	89,600
Yield point, lb. per sq. in	81,088
Elongation, per cent	24
Reduction of area, per cent	63
Brinell hardness	179

material for these stays. As an example of this from actual service conditions see Fig. 3, which is a photograph of a stay, one of six which were inserted in a firebox in the fire area for trial purposes October 20, 1922, and was removed for inspection after being nearly 12 years in service. There is not the slightest sign of

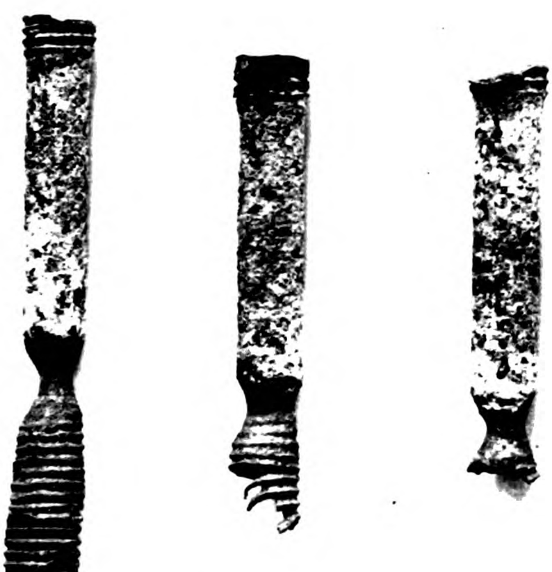


Fig. 2—Steel staybolts removed from service showing corrosion due to water impurities and electrolytic action

corrosion and the original machine marks can still be seen on the body of the stay. The Monel bar used by the Southern for these stays is of the hard, cold-drawn stress-relief annealed quality and is fabricated in exactly the same way as the mild steel stays used previously.

It is important that the threads on the stays be fully formed and of good finish so as to make contact accurately and tightly with the threads in the plate. The stays are arranged so as to project through the copper firebox plate normal to the surface—this is most important—to enable the nut to bed perfectly against the plate. If this is not done the stay end is liable to bend and fracture when the nut is screwed up to the plate and breakage may result.

The end of the stay projecting about $\frac{1}{4}$ in. through the outside firebox plate is lightly caulked by a suitable tool all around to a depth of about $\frac{1}{32}$ in., as shown in

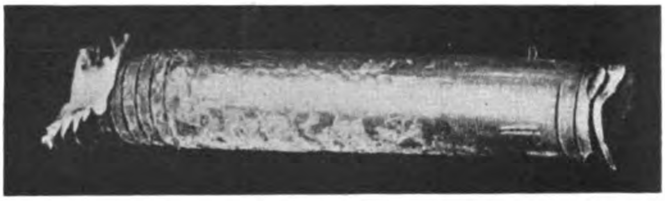


Fig. 3—Tool marks are still visible in Monel staybolt removed after nearly 12 years of service

Fig. 4, to insure steam tightness. The body of the stay, between the screwed ends, is plain and well finished with a generous radius so that abrupt change of form where the thread ends is avoided.

The nuts can be of iron or steel and should not be deeper than about $\frac{1}{2}$ in., as otherwise the heat is not transmitted through to the plate rapidly enough to avoid burning the material of the nut. These nuts are cheap and can be changed frequently as they burn and deteriorate so as to protect the ends of the stays and their threads from the effects of the fire.

The London, Midland & Scottish Railway also use this type of copper-firebox staybolt made of Monel in its modern engines working up to 250 lb. per sq. in. steam pressure. The Monel bar used is of the hot-rolled quality, but otherwise the practice of this road is identical with

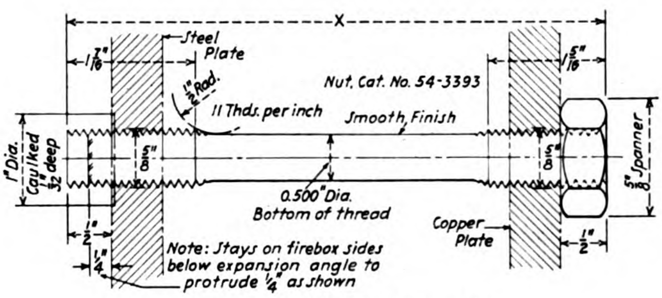


Fig. 4—Details of Monel staybolts

that of the Southern. The firebox of the Coronation Scot locomotive of the L. M. S., which has been sent with its train to the New York World's Fair, is fitted with Monel staybolts of this type. The technique of this company as regards the preparation and form of the stays and nuts is very similar to that of the Southern but the application varies slightly in some respects.

The main difference in the application of these two companies is that whereas the Southern make all the staybolts $\frac{5}{8}$ in. in diameter the L. M. S. use $1\frac{1}{16}$ in. diameter for all the staybolts with the exception of the two top rows and the front and back rows of the sides as well as the outer rows of the back and front firebox plates which are $\frac{3}{4}$ in. in diameter. This difference in the diameter of the staybolts used may be explained by the fact that the Southern employs a higher tensile material of cold rolled Monel bar (89,600 lb. per sq. in.)

while the L. M. S. uses the hot rolled Monel bar (67,200 lb. per sq. in.). The factor of safety in each case is about the same, viz: 7.5 to 8, which is higher than that of copper at firebox temperatures.

The use of Monel for staybolts by these two railways has been proved over years in service and has reduced the cost of firebox maintenance and with less leakage under the most arduous conditions. In the past where copper stays were used the work of caulking them to prevent leakage and the reheading of the stays added not only to maintenance costs but the wear and tear on the firebox plates was also very much increased. The renewal of copper stays with ever increasing diameter to

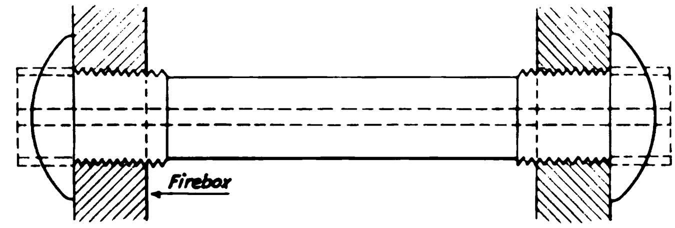


Fig. 5—Monel staybolts riveted at both ends

meet wear and tear and breakage added greatly to the cost of maintenance.

It can be stated with certainty that a broken Monel stay in service is so far unknown.

Nuts are stocked in reducing diameter of threads to allow for the wear of the threads on the stays. To meet those cases in which the screw thread has become too small for standard size nuts, a die nut is provided to rethread the end of the stay to take a smaller size nut.

Further it should be noted that copper stays have their strength very much impaired or reduced under the high temperature in the firebox so that the 31,000 lb. per sq. in. tensile strength of the copper bar under cold conditions may be reduced to 20,000 or 22,000 lb. per sq. in. Staybolts made of Monel on the other hand suffer no practical diminution of strength under the exalted temperature conditions of locomotive fireboxes.

Continental Practice

In France during the World War, owing to the difficulty in obtaining copper, hot rolled rods of Monel were used by the P. L. M. Railway for staybolts in substitution of copper, but as no reduction was made in diameter, notwithstanding the higher tensile strength of Monel over copper, they were found hard to rivet and leakage of the stays where screwed into the copper firebox occurred. These Monel rods were obtained from the United States and after the war when copper became available its use was resumed.

During the last few years the P. L. M. has had two locomotives having copper fireboxes fitted with Monel staybolts of cold-drawn hard material 18 mm. ($^{45}/_{64}$ in.) diameter having nuts on the fire side. It is said that leaking occurred but, it is agreed, this may have been due to indifferent screw threads or lack of technique in the application.

The Paris-Orleans section of the French railways has also been interested in Monel for staybolts and in 1934 fitted two Pacific type locomotives having steel inner fireboxes with these stays made of cold-drawn soft annealed Monel 23 mm. ($^{29}/_{32}$ in.) diameter, the heads of which were riveted as shown in Fig. 5. These stays were in replacement of cupro-manganese staybolts the heads of which are found to burn away rapidly. Although the results of the use of this trial of Monel staybolts are not definitely known it is understood they are satisfactory.

The railway in Alsace-Lorraine has just completed the fitting of a locomotive having the inner firebox of steel and the staybolts of 20 mm. ($^{25}/_{32}$ in.) diameter cold-drawn hard Monel, the heads of which have been welded at both ends as shown in Fig. 6.

The trials on the French railways of the use of Monel staybolts are being continued by fitting the two upper rows on each side of the steel fireboxes of locomotives now under construction as follows: 50 locomotives 2-10-0 type for the Nord, and 25 locomotives 4-6-2 type for the Sud-Est railway. For these engines the Monel stays will be 23 mm. ($^{29}/_{32}$ in.) diameter cold-drawn soft-annealed material with heads riveted at both ends. A further 10 locomotives are to be fitted similarly with Monel stays 22 mm. ($^{7}/_{8}$ in.) diameter cold-drawn soft-annealed material with heads riveted both ends.

The regulations on the French railways require that all staybolts shall be hollow. The hole through the stay while in service, is, by regular attention, kept free from any accumulation from the firebox so as to insure an indication should the stay become broken.

It was confidently stated by those consulted that so far as their trials had proceeded, no Monel stays had ever been found broken, which coincides with the experience in Great Britain where the use of Monel for this purpose is much more extended than in France.

In fitting Monel stays with the ends welded some care

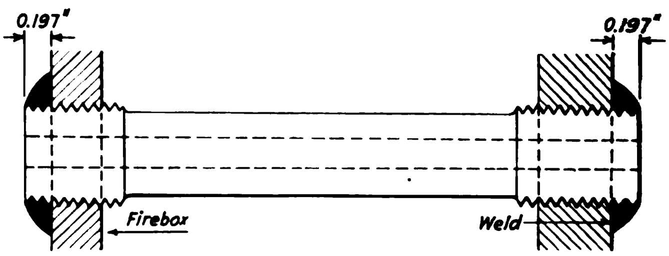


Fig. 6—Monel staybolt welded at both ends

is needed to insure a sound weld. To this end the stays are first screwed in as tightly as possibly after which the boiler is steamed so that the heat of the fire burns off all the oil from the threads, etc., before welding is commenced. In order to dissipate the heat during the process, the boiler has been filled with water, but if the threads are tightly fitting and the precaution to avoid the presence of oil is carefully observed, welding can be successfully done without the necessity of filling the boiler with water.

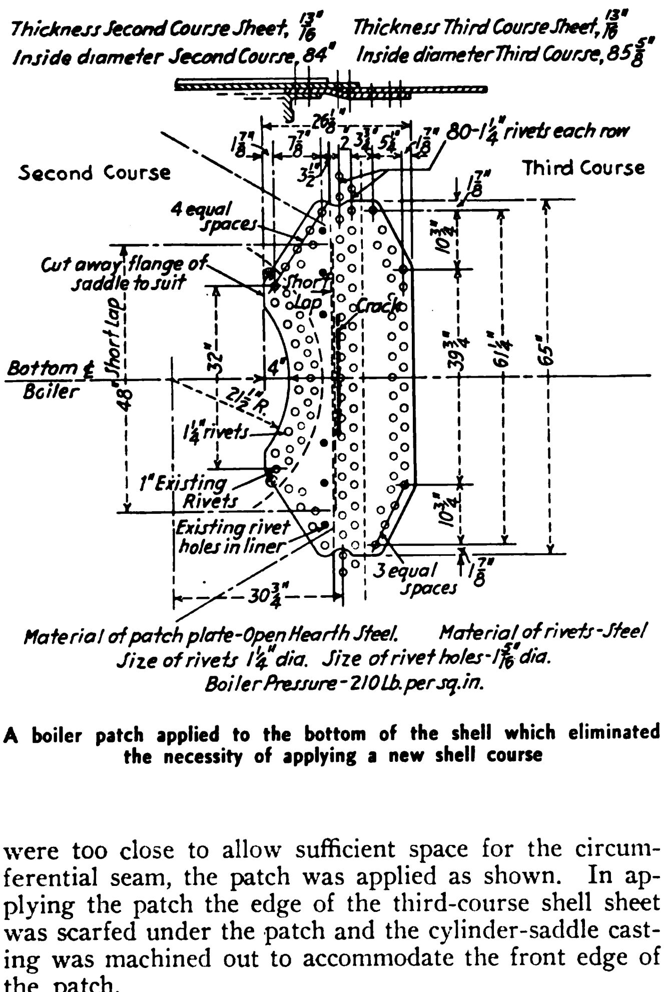
For permission to use the photographs, drawings and information illustrated and contained in this article the author is indebted to W. A. Stanier, chief mechanical engineer of the London, Midland & Scottish Railway, and to O. V. Bulleid, chief mechanical engineer of the Southern Railway, of England. The information, drawings and photographs used to illustrate the French Railway practice, etc., were provided and communicated by M. Bloch and M. Chan of the French Railways.

EMPLOYEES in all classes of service on the French National Railway must average seven hours of labor per day during the summer period and seven hours 10 minutes per day from October 15 to May 15, according to a decree recently issued by the government in connection with the establishment of a 45-hour week generally in industry.

A Boiler Problem—Prize Competition

The accompanying drawing and text describe the boiler patch selected by the judges, out of 28 entries, as the winner of the first prize in the competition announced in the March issue. It was submitted by Fred W. Strachauer, district boiler inspector, Southern Pacific, Sacramento, California.

The accompanying drawing shows a patch which was applied to the barrel of a 2-8-8-2 type locomotive boiler at the seam joining the second and third shell courses, just ahead of the rear pair of cylinders. The shell was cracked in the second course through the circumferential seam at the inner row of rivets. Because of the location of the crack, unusual conditions had to be met regarding both the design of the patch and the method of application. This design of patch made it unnecessary to apply a new section of the shell. Because of the fact that the caulking edge of the third course and the cylinder casting were too close to allow sufficient space for the circumferential seam, the patch was applied as shown. In applying the patch the edge of the third-course shell sheet was scarfed under the patch and the cylinder-saddle casting was machined out to accommodate the front edge of the patch.



A boiler patch applied to the bottom of the shell which eliminated the necessity of applying a new shell course

Had it been necessary to apply a section of the shell or a new full course, a heavy labor and material cost would have been incurred as a result of removing all the flues in the boiler. Inasmuch as the cylinder casting had to be removed anyway, it did not involve any additional expense to cut away the saddle in order to slip the patch sheet under the casting and, in order to apply the patch, only enough flues were removed to allow for holding-on the rivets for the saddle upon reapplication.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

The Application of Fusible Plugs

Q.—Are fusible plugs required in a locomotive boiler? If two or more fusible plugs are used, how is the number determined?—J. S.

A.—The Laws, Rules and Instructions for Inspection and Testing of Steam Locomotives and Tenders and their Appurtenances issued by the Bureau of Locomotive Inspection, I. C. C., does not require that fusible plugs be used in locomotive boilers; however, Rule 14 states that if boilers are equipped with fusible plugs they shall be removed and cleaned of scale at least once every month. Their removal must be noted on the inspection report.

The Committee on Fusible Plugs at the 1933 Convention of the Master Boiler Makers' Association recommended that when a multiple application of fusible plugs is used in a locomotive boiler, one plug should be placed at the highest point of the crown sheet between the first and second rows of stays and one additional plug for each 400 sq. in. of gas area of the flues. It was also recommended that these plugs should be spaced uniformly in the crown sheet on each side of the top center line of the crown sheet from front to back.

Correct Steam Piping to Dual Air Compressors

Q.—We have recently applied an additional air compressor to our 4-8-4 locomotives, which are now equipped with two compressors located on the bumper deck casting directly ahead of the smokebox. Since making this change we find that the air compressor on the left side seems to lag as compared with the one on the right side. What would cause such a condition?—R. E. C.

A.—The question does not go into any detail as to the manner of applying the compressors, especially in regard to the manner of piping. The trouble experienced would indicate that the steam supply to the compressors was not being distributed equally, one compressor getting considerable more than the other. The steam supply from the turret is generally brought from the steam turret to the compressors by a single 1½-in. line and at the compressors divided into two 1¼-in. lines, one to each compressor. It is important that where the division is made, a suitable fitting be used so that the steam is properly divided between the two outlets; tees should be avoided. Side-outlet elbows, Y-fittings or specially designed fittings should be used to insure a proper distribution of the steam to the two compressors. Also, it is important that the length of the pipe from the dividing fitting to the compressors be the same for each compressor; this can readily be arranged at the time the compressors are piped.

High Spots in

Railway Affairs . . .

Railroad Legislation Marking Time

The House of Representatives late on July 26 passed Railroad Bill S. 2009 after long, heated discussion and many amendments. At one time during the discussion Representative Martin, Democrat, of Colorado, suggested that the measure "rather than being for the benefit of the railroads" was rapidly becoming "a bill for the benefit of the waterway carriers, plus a lot of exemptions for agriculture." The bill as passed by the House varies in so many respects from that passed by the Senate, that there is little possibility of adjusting the differences between these two bodies in time to enact the legislation before adjournment. Senator Wheeler indicated that he would ask the Senate to send the bill to a joint House-Senate Committee for study and adjustment during the fall. It could then be passed promptly when Congress reassembles in January. Certainly, however, if it is to be of any great benefit to the railroads a lot will have to be done to it before it comes out of conference. Sharpshooting by high pressure groups in the House certainly put the kinks in it.

Transportation Round Table

The magazine Fortune recently called together 15 well-known men representing different interests, to discuss "Transportation Policy and the Railroads." Naturally there were many questions on which a group of such wide and varied interests could not see eye to eye, but here are six major principles of a national transportation policy upon which the round table unanimously agreed:

"(1) The railroads and other forms of internal transport should be placed upon an equal basis insofar as regulation and alleged government subsidies are concerned, except during a promotional stage.

(2) The principle of low rates should be the constant aim of transportation policy, and the carriers and Interstate Commerce Commission should remove any unjust regional preferences and work toward the gradual simplification of the general rate structure.

(3) The railroads should reduce costs, possibly by $300,000,000 a year, through effecting consolidations and co-ordinations.

(4) Any workers adversely affected by such economies should be protected by a dismissal wage; if given communities cannot afford to support given transportation facilities, such facilities should be either abandoned or frankly subsidized by government.

(5) A temporary government transportation committee should be established to co-operate with the carriers in effecting these and other economies and to lay the foundations for a national transportation policy, aimed at developing each branch of transport in accordance with its inherent advantages.

(6) Although the rehabilitation of the railroads will contribute to general recovery, we can have a healthy transportation system only when we have a healthy economy."

Unemployment Insurance Payments Start

Payments under the provisions of the Railroad Unemployment Insurance Act, which was rushed through Congress near the close of the session a year ago, were started about the middle of July this year. It may be recalled that the statement was made last year by the publication "Labor" that this particular bill went through the Senate "in exactly 4½ minutes—breaking all records for speed in enacting legislation." The benefits are payable for a maximum period of 80 days to those workers who qualify and can show that they earned $150. in the previous year. Benefits computed on a daily basis range from $1.75 to $3. per day, so that the maximum payable to any one individual is $240. a year. The Railroad Retirement Board announced that about 65,000 claims for benefits are on file.

Changes in High Places

July witnessed several changes in important executive positions. Upon the retirement of Hale Holden as chairman of the Southern Pacific, the headquarters of that road were shifted from New York to San Francisco, leaving only the financial officers in the East. A. D. McDonald, the president, took over the duties and authority of the chairman. Four new directors were elected, all from the West Coast, and the new executive committee now consists entirely of West Coast members. * * * * * Near the end of the month Rowland L. Williams was made chief executive officer of the Chicago & North Western, succeeding Fred Sargent, who resigned on June 1. Most of Mr. Williams' railroad career has been with the Chicago & Eastern Illinois. After having had experience in several departments he became chief statistician and then was assigned to special research, in the effort to improve the efficiency of operation and effect economies. He made good to such an extent that he was senior executive assistant of the C. & E. I. when called to the North Western.

Railroad Employment Going Up

According to the Interstate Commerce Commission's compilation, based on preliminary reports, the number of employees on Class 1 railroads, excluding switching and terminal companies, on June 15, 1939, was 991,900, an increase of 3.58 per cent over May 15 of this year, and of 8.39 per cent as compared to June 15, 1938. One must go back to December 15, 1937, to find a higher figure, 1,006,462; never during the year 1938 did it approach the million mark at the middle of any month. In that year a low of 905,573 was registered in May, and a high of 976,374 in October. In only one month, however, did it go below the million mark in 1936. It was 981,853 on January 15, 1936—the high for that year being 1,108,970 in October.

Mechanical Equipment Costs

Each year the Engineering Section of the Bureau of Valuation of the Interstate Commerce Commission publishes cost statistics for railroad construction. The index number for steam locomotives in 1938 was 204, exactly the same as in 1937. It was 86 in 1915, advancing rapidly during the following years until it reached 248 in 1920. It dropped back sharply to 192 in 1921 and to 179 in 1922. It bobbed back up to 197 in 1923, but since that time never went above 194 (1930) until 1937, when it reached 204, as above noted. The story for freight cars did not follow quite the same course. From a low of 101 in 1915 it advanced to 284 in 1920, dropping back to 184 in 1921 and 156 in 1922. It climbed back up to 200 in 1923, but remained well below that figure until it jumped from 179 in 1936 to 191 in 1937, dropping back a point to 190 in 1938. The story of passenger train car prices is not nearly as exciting, possibly because there was less pressure for increasing this equipment during the war years than was true in the case of locomotives and freight cars. From a low of 89 in 1915 it advanced to a high of 213 in 1920, dropping to 169 in 1921 and 152 in 1922. It climbed back up to 192 in 1923, but except for 191 in 1927, remained below 189 until 1937, when it went to 195, remaining at the same figure for 1938.

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ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE,
NEW YORK, N. Y.

445 N. SACRAMENTO BLVD.,
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ORGANIZED TO ACHIEVE:
Uniform Specifications
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Among the Clubs and Associations

Four Mechanical Associations To Meet in October

PROGRAMS are being completed for the conventions of the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association, the International Railway General Foremen's Association, and the Master Boiler Makers' Association, which will be held simultaneously at the Hotel Sherman, Chicago, October 17, 18 and 19. A general session will be held by all four associations on the morning of Tuesday, October 17, at which time the combined memberships will be addressed by L. W. Baldwin, chief executive officer, Missouri Pacific, who will speak on Training and Coaching Supervision. Following this session, each association will continue with its own program in its own meeting room.

Fuel and Traveling Engineers' Association Program

ARRANGEMENTS are being made for special speakers on Mechanical Day and Fuel Day of this association. Individual papers on fuel and locomotive performance will be presented by J. G. Crawford, fuel engineer, C. B. & Q.; F. P. Roesch, vice-president, Standard Stoker Co., Inc.; and W. A. Hurley, superintendent, New York, New Haven & Hartford, Boston, Mass. E. L. Woodward, western editor, *Railway Mechanical Engineer,* will discuss what members can do to promote the effectiveness of the association. Committees will report on:

Stationary Power Plants—Various Fuel-Burning Appliances That Affect Fuel Economy
Coal Preparation, Inspection and Utilization, Dealing Especially with Washed and Dried Coals
Locomotive Firing (coal), Dealing Especially with Honeycombing
Locomotive Firing Practice (oil)
Steam Turbine and Steam-Condensing Locomotives
Air Brakes
Fuel Records and Statistics
Grates
Utilization of Locomotives

Car Department Officers' Association Program

ROY V. WRIGHT, editor, *Railway Mechanical Engineer;* C. H. Dietrich, executive vice-chairman, Freight Claim Division, Association of American Railroads, and Leroy Kramer, vice-president, General American Transportation Corporation, are among the speakers on the program of the Car Department Officers' Association. On the successive days of the meeting committee reports will also be presented on Freight and Passenger Car Construction and Maintenance; Shop Operation, Facilities and Tools; Passenger-Train-Car Terminal Handling; Lubricants and Lubrication; Freight-Car Inspection and Preparation for Commodity Loading; Interchange, and Loading Rules, and Billing for Car Repairs and Painting.

General Foreman's Association Program

SPEAKERS scheduled to address successive sessions of the General Foremen's meeting and the subjects of their talks are: D. S. Ellis, chief mechanical officer, C. & O.—Proper Maintenance of Modern Locomotives; A. H. Williams, general supervisor of apprentices, Canadian National—Training of Apprentices; Fred H. Williams, assistant test engineer, Canadian National—Failures of Locomotive Parts and How to Prevent Them, and F. E. Lyford, trustee, New York, Ontario & Western—What I Expect of My Supervisors—and Why! There will also be an address by a representative of the Allied Railway Supply Association and a number of papers on various practical aspects of the maintenance, repair, or servicing of locomotives. Reports will also be made on the recommendation made at the meeting last October of the officers and executive committee of the International Railway General Foremen's Association that the name of the association be changed to the Locomotive Maintenance Officers' Association.

Master Boiler Makers' Association Program

TENTATIVE plans for the meeting of the Master Boiler Makers' Association call for addresses by the president of the association, William N. Moore, general boiler foreman, Pere Marquette; by Roy V. Wright, editor, the *Railway Mechanical Engineer;* D. S. Ellis, chief mechanical officer, Chesapeake & Ohio; by F. K. Mitchell, assistant superintendent of equipment, Cleveland, Cincinnati, Chicago & St. Louis, and by J. M. Hall, chief, Bureau of Locomotive Inspection, Interstate Commerce Commission. Committee reports will be made on nine topics:

Technical and practical training of boilermaker apprentices; Advantages and disadvantages of all-welded and alloy steel for locomotive cisterns to decrease weight and reduce pitting and corrosion; Means to further improve steaming qualities in the locomotive boiler and eliminate leaking staybolts and cracking of firebox sheets; Treating boiler feedwater chemically; Standard practice for locating height of crown sheet, water-glass and gage cocks and low-water-alarm drop pipe; Cause for flues and tubes cracking longitudinally through head; Recommendations for standardizing inspection, testing, and cleaning of locomotive air reservoirs; Recommendations for the renewing of fireboxes, and topics for 1940 meeting. An individual paper on the first topic will be presented by a representative of the Federal Committee on Apprenticeship, United States Department of Labor, Washington, D. C.

Machine Tool Show at Cleveland, Ohio

THE 1939 Machine Tool Show of the National Machine Tool Builders' Association will be held at the Cleveland Public Auditorium from October 4 to 13 inclusive. The member companies of the Association are making an outlay of over $3,000,000 to assemble a machine tool and allied equipment display involving more than 1,000 machines of approximately 600 types. In extending an invitation to railroad men to visit this year's show W. E. Whipp, president, Monarch Machine Tool Company and president of the National Machine Tool Builders' Association says, "To railroad men concerned with problems of operating costs in repair and maintenance shops, this show will display many new developments worth careful study. Improvements in machine-tool design developed during the past five years and now being included in new machines have made remarkable strides in the direction of increased productivity and economy of operation. In these days when costs must be pared to the bone and profit margins are mighty slim at best, the Machine Tool Show may present to railroad executives opportunities for savings in operating expenses far greater than have heretofore been possible."

During the show there will be a number of technical meetings with programs sponsored by the American Society of Mechanical Engineers, American Society of Tool Engineers, American Foundrymen's Association, Society of Automotive Engineers and the Cleveland Engineering Society.

The arrangements for the Machine Tool Show are under the direction of a Show Committee headed by Walter Tangeman, vice president, Cincinnati Milling Machine Company.

Eastern Car Foreman's Outing

APPROXIMATELY 200 railroad and supply men and guests attended the annual outing and golf tournament of the Eastern Car Foreman's Association at the Race Brook Country Club, New Haven, Conn., on Thursday, July 13. A number of prizes were awarded in the golf tournament, the winners of which were as follows: Class A—Low gross, T. M. Ferguson, American Arch Company; low net, H. Nuhn, B. & A. Class B—low gross, W. K. Krepps, Crucible Steel Company; low net, A. W. Brown, Air Reduction Sales Company. Class C—low gross, E. W. Ball, N. Y. N. H. & H.; low net, G. A. Price, American Arch Company. The arrangements for the outing were under the direction of J. P. Egan, president of the association and F. H. Becherer, general chairman.

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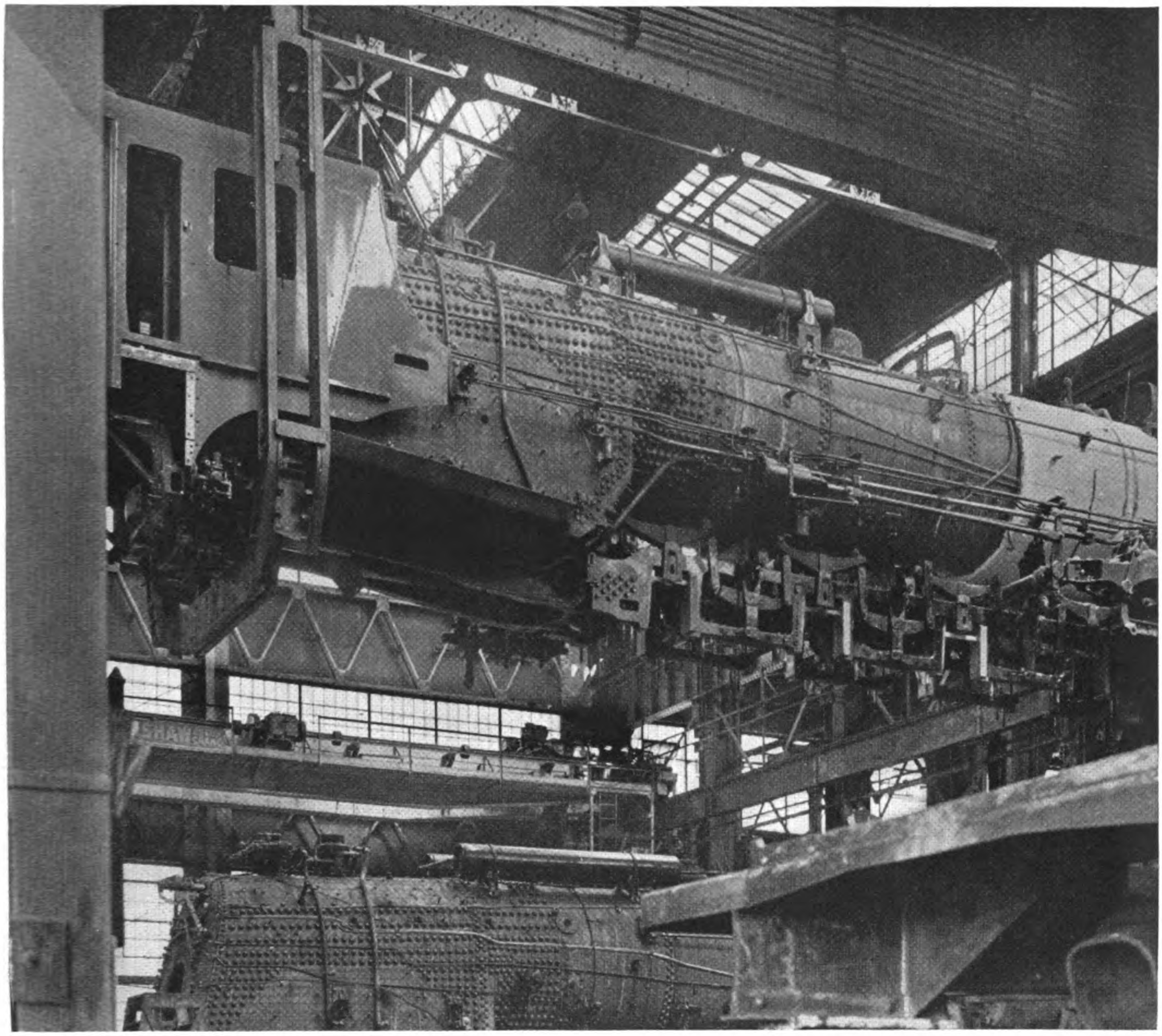
METHODS AND MACHINERY THAT GUARD LIMA QUALITY



Lima Locomotives are "HANDLED WITH CARE"

Even when lifting a locomotive Lima uses special equipment that results in the minimum of strain on the locomotive structure. » » » From beginning to end in its manufacturing operations Lima bears in mind the ultimate service of its product. Every precaution is taken to build low maintenance and dependable service into every locomotive that leaves the Lima shops.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

— NEWS —

The first of two 2,000-hp. Diesel-electric locomotives to be completed at the plant of the Electro-Motive Corporation for use on the Denver Rocket of the Chicago, Rock Island & Pacific between Chicago and Denver—The locomotive, which is now being operated in test runs, is 71 ft. 4 in. long, weighs 206,490 lb., has a 2,000 hp. power plant, and is rated at a maximum speed of 117 m. p. h.—It is equipped with six-wheel trucks

Equipment Depreciation Orders

EQUIPMENT depreciation rates for seven railroads are prescribed by the Interstate Commerce Commission in a new series of sub-orders and modifications of previous sub-orders in No. 15,100, Depreciation Charges of Steam Railroad Companies. The composite percentages for all equipment, which are derived from the individual prescribed rates, range from 3.1 per cent for the Western Pacific to 6.72 per cent for the Middletown & Unionville.

Other roads on the list are: Elgin, Joliet & Eastern; Flemingsburg & Northern; Minnesota Transfer; Union Terminal of St. Joseph, Mo.; and the Ventura County.

133 M.P.H. Attained on German State Railways

AN average speed of 124 m.p.h. for the 186-mile stretch between Berlin, Germany, and Hamburg was chalked up by a new three-car, Diesel-propelled train of the German State Railways recently, according to an official report of June 26. It is further stated that the new train held a top speed of 133 m.p.h. for 25 min. during the test run.

The road bed over which the test train made the record was rebuilt in 1932 for high-speed traffic, and the fast "Flying Hamburger," a pioneer Diesel streamliner, has been operated regularly over it since the spring of 1933. This train, operating daily in both directions, is scheduled to run between Berlin and Hamburg in 137 min. or at an average speed of 81.4 m.p.h.

The new train is powered by two Maybach Diesel engines of 600 hp. each. Its top speed of 133 m.p.h. is claimed to be the world's record in railroad speeds. According to *Railway Age* records the Pennsylvania Special (now the Broadway Limited) reached a speed of 127.2 m.p.h. for a distance of three miles between Elida, Ohio and AY tower on June 12, 1905.

All-Coach Fast Trains Between New York and Chicago

NEW fast, deluxe, all-coach trains with lounge-buffet facilities, porter service, individual adjustable seats and other former extra-fare amenities to which the coach traveler is becoming heir, were placed in operation by the New York Central and the Pennsylvania, respectively, between New York and Chicago on July 28. Representing the first long-distance exclusively coach trains established by any eastern carrier, the new runs offer patrons the new low-rate round-trip coach fare of $30.90 (at the rate of 1.7 cents per mile) between the two termini which became effective June 30, with no additional charges for special features.

Both trains are air-conditioned throughout; provide special dimmed illumination during sleeping hours; and carry a lounge car open for use by all passengers.

The New York Central's train is named the "Pacemaker" and operates on a schedule of 17 hours in each direction between the two points.

The Pennsylvania's "Trail Blazer" covers the westbound trip in 17 hr. and the eastbound in 17 hr. 25 min., averaging a little more than an hour longer than the fastest schedule over the route—that of the extra-fare "Broadway Limited."

Experimental Car Construction Authorized by I. C. C.

The General American Transportation Corporation has been granted authority by the I. C. C. to construct for experimental service in the transportation of caustic soda solution 50 tank-cars fabricated by the fusion-welding process.

The American Car and Foundry Company has been authorized by the Interstate Commerce Commission to construct for experimental service in the transportation of petroleum products 10 tank cars of 8000 gal. capacity, with tanks fabricated by the fusion-welding process.

Locomotive Rebuilding

The Illinois Central will convert six locomotives of the 2-10-2 type to 4-8-2 type locomotives.

The Great Northern is rebuilding 10 locomotives of the N-2 Class.

Activities of the Railroad Retirement Board

THE Railroad Retirement Board, on June 15, ordered the director of wage and service records to prescribe a change in the reporting practices of all employers who report to the Board on a weekly payroll basis whereby all compensation earned after June 30, 1939, shall be reported separately from compensation earned on or before that date. This was recommended by the director of unemployment insurance in view of the provisions of the Railroad

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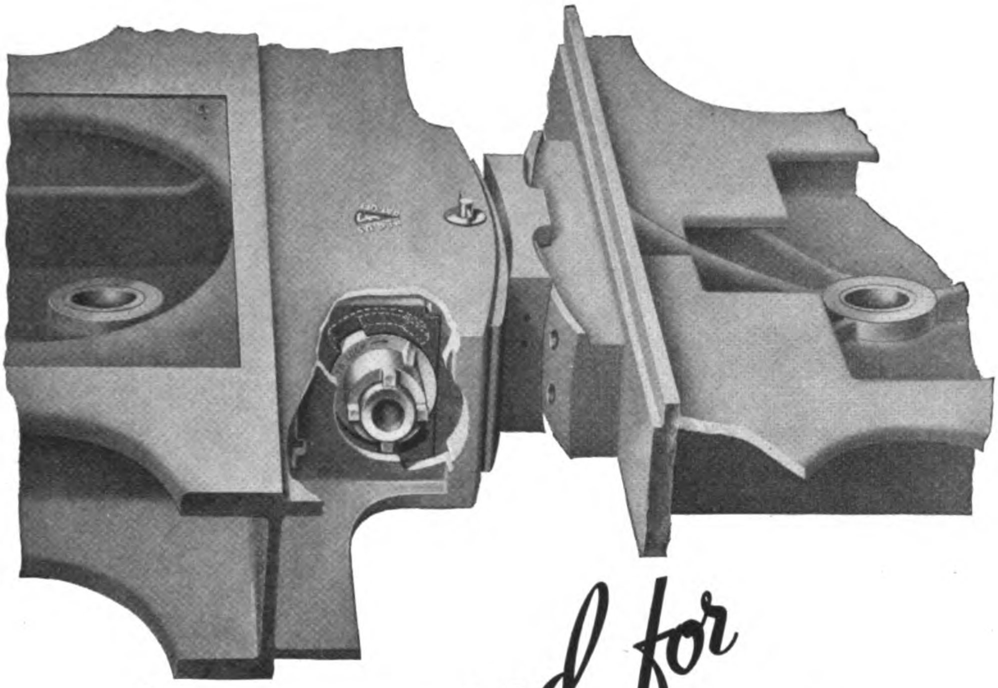
New Equipment Orders and Inquiries Announced Since the Closing of the July Issue

	LOCOMOTIVE ORDERS		
Road	No. of Locos.	Type of Loco.	Builder
Seaboard Air Line	2[1]	2,000-hp. Diesel-elec.	Electro-Motive Corp.
	PASSENGER-CAR ORDERS		
Road	No. of Cars	Type of Car	Builder
A. T. & S. F.		See Note[2]	....
Seaboard Air Line	14[3]	Lightweight	Edw. G. Budd Mfg. Co.
	FREIGHT-CAR INQUIRIES		
Road	No. of Cars	Type of Car	Builder
N. Y. C. & St. L.	10	Gon. type container	....

[1] For operation on lightweight passenger trains.
[2] The Santa Fe has ordered 11 streamline lightweight passenger cars, placing seven with the Pullman-Standard Car Manufacturing Company and four with the Edward G. Budd Manufacturing Company. The seven cars include one 36-ft. dining car, one lounge-lunch counter-dining car, two baggage-chair cars, one baggage-dormitory chair car, one chair-observation car and one club-lounge car. The four cars include two post office cars and two club-chair cars.
[3] For two streamline trains of seven cars each.



"Engineered for Easy riding"

The Type E-2 Radial Buffer makes a safer, easier riding locomotive. » » » Its spherical and cylindrical faces permit movement in any direction, while its predetermined frictional resistance dampens oscillation between engine and tender, prevents lost motion and subsequent destructive shocks to drawbar and pins. » » » Its twin, the Franklin Automatic Compensator and Snubber, takes the job of maintaining proper driving box adjustment that further improves smoothness of operation and extends locomotive mileage and reduces maintenance costs. It is particularly essential on roller bearing boxes.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Unemployment Insurance Act which require contributions by employers based on employment after June 30, 1939.

The general counsel of the Board has ruled that the value of meals and lodging furnished by an employer is not creditable as compensation under the Railroad Retirement Act, unless it is established that the employer and the employee have agreed before the performance of the service upon the amount of compensation, and that part of the compensation for the job was to be paid in the form of meals and lodging, and that the meals and lodging were to have a definite value.

Supply Trade Notes

J. L. LAVALLEE, sales manager of the railway sales division of The Texas Company, New York, has been appointed manager of the railway traffic and sales department at New York, succeeding W. E.

J. L. Lavallee

Greenwood, retired. Mr. Lavallee entered The Texas Company's service at Houston, Tex., in November, 1922, after many years experience in railroad service as lubrication engineer. He was appointed assistant manager of railway sales at Chicago in July, 1928, and sales manager at New York in October, 1937. Mr. Greenwood, who retired on June 30, entered service in April, 1912, as representative of the railway sales division at New York, advancing successively to the positions of assistant manager, manager, and general manager.

◆

C. H. WILLIAMSON has been elected vice-president of the Youngstown Steel Door Company, Cleveland, Ohio. Mr. Williamson was born on December 29, 1884, at Renova, Pa., and was educated at Dickinson Seminary, Williamsport, Pa. He entered the Townsend Scientific school of the University of Pennsylvania with the class of 1907, and in October of the following year went with the Pennsylvania

C. H. Williamson

Railroad as car repairman at Bellwood, Pa. In January, 1909, he was transferred as draftsman to the office of the general superintendent of motive power; in March, 1917, became assistant foreman of freight-car design, and in September, 1918, was made foreman in charge of freight-car design. He resigned on April 1, 1920, and became associated with the development of steel doors for box cars, becoming mechanical engineer of the Youngstown Steel Door Company, with headquarters at Cleveland, when that company was organized in January, 1925. In June, 1935, he was appointed assistant vice-president.

◆

M. ISELDYKE, JR., vice-president of The Q & C Company, New York, has been elected president. R. R. Martin, who has been with the company for 24 years, was elected secretary and treasurer. Both of these officers will also serve on the board of directors. W. M. Vinnedge, southeastern railroad sales representative of the Worthington Pump & Machinery Corporation at Harrison, N. J., has been appointed eastern district sales manager of The Q & C Company, with headquarters at New York.

M. Iseldyke, who started his career in the mechanical department of the Delaware, Lackawanna & Western, has been

M. Iseldyke, Jr.

with The Q & C Company since 1913, serving as secretary for a number of years.

W. M. Vinnedge was born on March 15, 1895, at Lafayette, Ind., and was educated in electrical engineering at Purdue university, graduating in 1916. After his graduation he entered the service of the Western Electric Company as an apprentice at Pittsburgh, Pa., being transferred to the sales department with headquarters at Omaha, Nebr., in 1917. Shortly thereafter, Mr. Vinnedge went with the General Electric Company as a sales engineer at New York, remaining with that company until 1921, when he became connected

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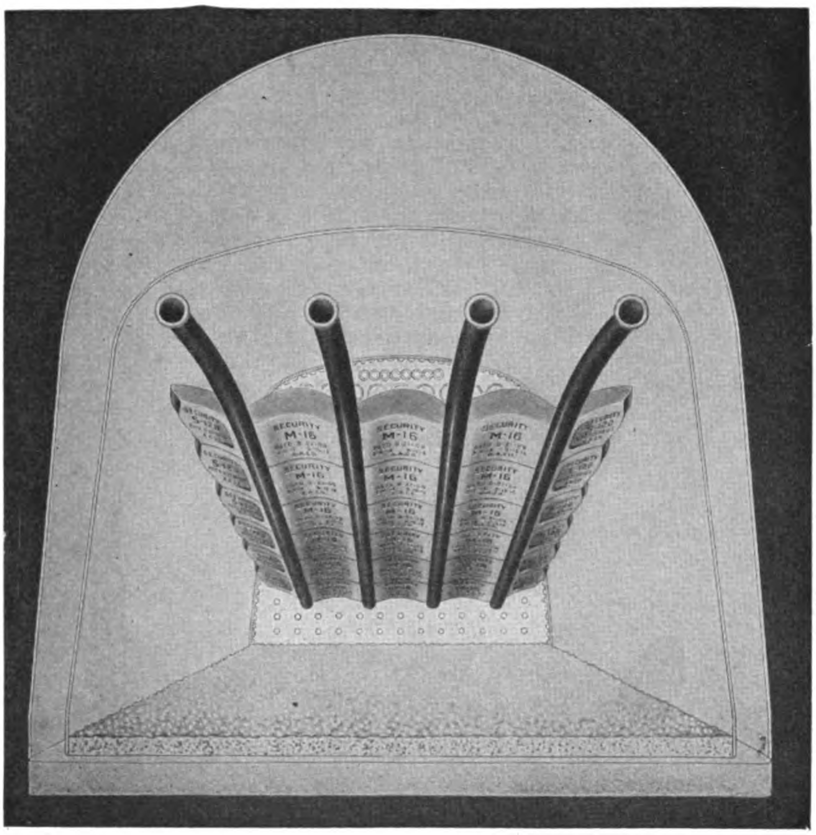
* * *

Samuel M. Vauclain inspecting the first locomotive of an order of twenty-eight 4-8-8-2 type now under construction at the Baldwin Locomotive Works for the Southern Pacific, following ceremonies on July 13, the locomotive was formally delivered to F. E. Russell, mechanical engineer of the Southern Pacific. President Charles E. Brinley of the Baldwin Locomotive Works is looking down from the cab window



ANYTHING
less than a complete arch
IS FALSE ECONOMY

To let the desire for reduced inventory result in a locomotive leaving any roundhouse without a full set of Arch Brick is poor economy. » » » Even a single missing Arch Brick will soon waste many times its cost in fuel and in locomotive efficiency. » » » To spend the fuel dollar efficiently, every locomotive Arch must be maintained 100%. » » » Be sure your stocks on hand are ample to provide fully for all locomotive requirements, so that locomotive efficiency may be maintained.

There's More to SECURITY ARCHES Than Just Brick

HARBISON-WALKER REFRACTORIES CO.
Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.
Locomotive Combustion Specialists

with the American Brown Boveri Company, as a sales engineer at Camden, N. J. In 1925 he became manager of sales of portable air compressors for Metalweld, Inc. Five years later, when the business of Metalweld was acquired by the Worthington Pump & Machinery Corporation,

W. M. Vinnedge

Mr. Vinnedge entered the service of the Worthington Company as a sales representative. In 1932 he was appointed eastern regional manager of sales of locomotive feedwater heaters, with headquarters at Harrison, N. J. In 1938, he became southeastern railroad sales representative with the same headquarters.

◆

H. L. ANDREWS, vice-president of the General Electric Company, in charge of the company's transportation activities, is now vice-president in charge of the appliance and merchandise department, with headquarters at Bridgeport, Conn. Guy W. Wilson, assistant manager of the transportation department, has been appointed manager of that department, with headquarters at Erie, Pa., to succeed E. P. Waller, who has been appointed assistant to E. O. Shreve, vice-president in charge of apparatus sales. Mr. Waller's headquarters are at Schenectady, N. Y.

H. L. Andrews is a native of Missouri; he was graduated from the University of Missouri in 1910, with a degree of B. S. in E. E., and entered the testing department of General Electric the same year. In 1912 he was transferred to the railway motor department, and in 1916 to the railway engineering department. A year later he was placed in charge of car equipment. Late in 1925, Mr. Andrews was appointed assistant engineer in administrative charge of the department, and in 1929 was appointed engineer. He had also been responsible for general commercial matters in the transportation field. On May 25, 1934, Mr. Andrews was elected vice-president in charge of the activities connected

H. L. Andrews

with the electrification of steam railroads and such other duties as might be assigned to him by the president. In June, 1935, Mr. Andrews assumed responsibility for all departments of the company's transportation activities.

Guy W. Wilson, who has been appointed manager of the transportation department, entered the employ of the General Electric Company in June, 1923, immediately after his graduation from Penn State University. He served on "test" for six months and in December was assigned to the fac-

Guy W. Wilson

tory division of the railway equipment and engineering department at Schenectady. Since May, 1926, he has been associated with the general office division of that department at the Erie works, until last month when he and Henry Guy were named assistant managers.

E. P. Waller, who returns to Schenectady with his new appointment as assistant to vice-president in charge of apparatus sales, entered the employ of the General Electric Company in 1900, upon graduation from the Virginia Polytechnic Institute. After two years in "test," he became associated

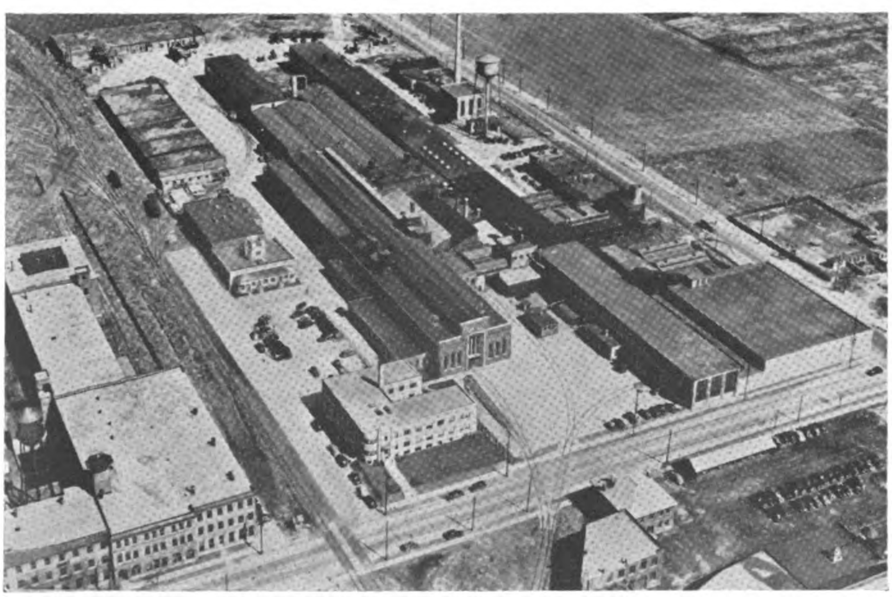
E. P. Waller

with the publication bureau, forerunner of the present publicity department. When the General Electric Review was instituted he became associate editor, leaving in 1903 to take up commercial work in the railway department. In 1912 Mr. Waller was appointed assistant manager of the railway department and in 1922 was named manager of the department, which later was renamed the transportation department.

◆

J. T. GILLESPIE, JR., assistant manager of the central division of railroad sales of the Air Reduction Sales Company at Chicago, has been appointed assistant to Thomas B. Hasler, president of the Wilson Welder and Metals Co., Inc., an affiliate of

* * *



Expanded plant of the American Manganese Steel Division of the American Brake Shoe & Foundry Company at Chicago Heights, Ill.

Among the new buildings are an employees' welfare building, a heating plant, and additions to the foundry, pattern storage, machine shop, and shipping room.

AIRCO. Mr. Gillespie will have his headquarters at New York and in his new duties will handle promotional sales activities in co-operation with I. B. Yates, general sales manager of the Wilson Welder and Metals Co., Inc.

◆

M. M. Beckwith, recently in charge of the Chemical Laboratory of the Guide Lamp Division of the General Motors Corporation, has joined the staff of The J. B. Ford Company, metal-cleaning department, at Wyandotte, Mich.

◆

C. D. Marshall, chairman of the executive committee of the board of trustees of Koppers United Company, resigned July 24. To succeed Mr. Marshall as chairman, the executive committee has elected J. T. Tierney. Mr. Tierney also continues as president and Mr. Marshall retains his membership on the board. Mr. Tierney will also be chairman of the board of Koppers Company, resigning his position as president of this principal operating unit of the Koppers organization. He will be succeeded as president of Koppers Company by J. P. Williams, Jr., who for some years has been vice-president of Koppers United Company and president of The Koppers Coal Company. Mr. Williams will serve also as executive vice-president of Koppers United Company.

◆

Standard Equipments, Chicago, has changed its name to Alcoma Railway Equipments. There will be no change in personnel and its headquarters will remain as before at 310 S. Michigan avenue.

◆

The Armco Railroad Sales Company has taken over the railroad sales business heretofore conducted by the Ingot Iron Railway Products Co. The Drainage Engineering Company continues to carry on its business in conjunction with Armco.

◆

Obituary

J. T. Geoghegan, sales engineer of the American Car and Foundry Company, at Chicago, died on June 6.

Carl Mosier, vice-president of the Union Asbestos & Rubber Co., with headquarters at Chicago, died suddenly in that city of a heart attack on July 17.

◆

Charles E. Robinson, who has been connected with the Baldwin Locomotive Works since 1899, died on July 20 at the age of 62, as the result of an automobile accident which occurred on July 9. Mr. Robinson at the time of his death was manager of the Engineering Department, a branch of the business in which he had held many positions during his 40 years with Baldwin.

◆

William R. Bush, sales representative in the eastern region of the transportation department of Johns-Manville Sales Corporation, with headquarters at Washington, D. C., died at the Lee Memorial Hospital in Norfolk, Va., July 25, after a brief illness. Mr. Bush was born in Knoxville, Tenn., in 1892 and entered service with Johns-Manville in 1921, having previously been associated with the Southern for a number of years.

Personal Mention

General

John P. Morris, whose promotion to general assistant, mechanical department, of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, was announced in the July *Railway Mechanical Engineer,* was born at Fort Madison, Iowa, on March 4, 1889, and entered the service of the Santa Fe as a machinist apprentice at Fort Madison in 1904. In February, 1911, he was promoted to machinist, and in January, 1916, was advanced to assistant enginehouse foreman. Mr. Morris became general enginehouse foreman in July, 1917, general foreman in April, 1923. On November 1, 1924, he became master mechanic of the Illinois division with headquarters at Chicago; on July 1, 1937, was appointed mechanical assistant at that point, and on April 1, 1938, was appointed mechanical superintendent of the Eastern mechanical district of the Eastern lines, with headquarters at Fort Madison, Iowa.

John P. Morris

Oscar G. Pierson, whose promotion to mechanical superintendent on the Atchison, Topeka & Santa Fe, with headquarters at Fort Madison, Ia., was announced in the July *Railway Mechanical Engineer,* was born at Topeka, Kan., on June 1, 1889, and entered railway service on April 30, 1907, as a machinist apprentice on the Santa Fe at Topeka. On April 1, 1912, he was promoted to foreman of the air-brake room and two years later was transferred to Argentine, Kan., as machinist gang foreman. On February 20, 1916, he was promoted to night enginehouse foreman at Arkansas City, Kan., and a year later was transferred to a similar position at Argentine. Mr. Pierson resigned in December, 1917, to accept work in the Navy Yard at Washington, D. C., and on January 4, 1919, returned to the Santa Fe as a machinist at Argentine. From June 19, 1919, until November 1, 1920, he served successively as machinist gang foreman, air-brake foreman, and enginehouse foreman at Argentine. On the latter date he was promoted to general foreman at Arkansas City, and on September 1, 1937, was appointed master mechanic of the Oklahoma and Southern Kansas division, with headquarters in the same city.

Oscar G. Pierson

William H. Clegg, chief inspector of air brakes and car-heating equipment of the Canadian National at Montreal, Que., has been appointed general superintendent of motive power of the Grand Trunk Western, with headquarters at Battle Creek, Mich., to succeed Burt J. Farr, deceased. Mr. Clegg was born at Ledston, Yorkshire, England, on March 30, 1882, and entered railway service in 1902, as an air-brake repairman on the Canadian Pacific at Winnipeg, Man. From 1906 to 1910, he served as a locomotive fireman, returning in the latter year to his position as air-brake repairman at Winnipeg. Later

William H. Clegg

(*Continued on second left-hand page*)

More

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that year he was advanced to air-brake foreman at that point and in 1911, he went with the Canadian Northern (now part of the Canadian National system) as air-brake foreman at Winnipeg. Mr. Clegg was appointed air-brake instructor, with the same headquarters in 1913, and in 1916, was transferred to Toronto, Ont. In 1919, he was promoted to supervisor of air brakes, and the following year was appointed superintendent of air brakes on the Canadian National with headquarters, as before, at Toronto. His title was changed to chief inspector of air brakes and car-heating equipment, with headquarters at Montreal, in 1923. Mr. Clegg has been president of the Air Brake Association since 1930 and is also at the present time chairman of the Air Brake Committee of the Association of American Railroads.

Walter O. Teufel, master mechanic on the Pennsylvania at Columbus, Ohio, has been promoted to superintendent of the Indianapolis division, with headquarters at Indianapolis, Ind. Mr. Teufel was born at Milton, Pa., on July 30, 1897, and attended Pennsylvania State College. He entered railway service on April 10, 1916, as an apprentice in the mechanical department of the Pennsylvania. On October 1, 1922, he was appointed motive-power inspector and on February 15, 1926, was promoted to assistant master mechanic at Wilmington, Del. Mr. Teufel was transferred to Altoona, Pa., on March 1, 1930, and on January 1, 1931, was promoted to master mechanic at New Castle, Pa. On May 1, 1932, he was appointed assistant master mechanic at New York and on November 1, 1933, was advanced to master mechanic at Buffalo, N. Y. Mr. Teufel was later transferred to Pittsburgh, Pa., and Columbus, Ohio.

Walter O. Teufel

Master Mechanics and Road Foremen

A. D. Haley, assistant master mechanic of the Illinois Central at Markham Yard, Chicago, has been promoted to master mechanic at McComb, Miss.

H. T. Cover, master mechanic of the Pennsylvania at Wilmington, Del., has been transferred to Columbus, Ohio, succeeding Walter O. Teufel.

J. L. Marks, assistant master mechanic of the Pennsylvania at Harrisburg, Pa., has been appointed master mechanic with headquarters at East Altoona, Pa.

C. O. Shull, master mechanic of the Western Pennsylvania division of the Pennsylvania at Pitcairn, Pa., has been transferred to the position of master mechanic at Wilmington, Del.

B. J. Murtha, engineman, Philadelphia Terminal division of the Pennsylvania, has been appointed assistant road foreman of engines of the Maryland division, with headquarters at Baltimore, Md.

H. C. Wright, foreman enginehouse and car shops of the Pennsylvania at Grand Rapids, Mich., has been appointed assistant master mechanic of the Philadelphia division, with headquarters at Harrisburg, Pa.

E. R. Buck, master mechanic of the Pennsylvania at East Altoona, Pa., has been transferred to the position of master mechanic of the Conemaugh and Monongahela divisions, with headquarters at Pittsburgh, Pa.

F. C. Gorom, master mechanic of the Great Western, has been appointed superintendent and master mechanic, with headquarters as before at Loveland, Colo., succeeding C. E. Angove, retired.

Car Department

Charles E. Richard has been appointed acting foreman, car department, of the Canadian National at Riviere du Loup, Que., succeeding O. St. George, retired.

Shop and Enginehouse

G. R. Miller, who has been appointed superintendent of shops of the Atchison, Topeka & Santa Fe, at Albuquerque, N. M., as announced in the July issue, was born on April 23, 1887, in Germany. He obtained a common school education and entered the service of the Santa Fe on July 21, 1903, as a machinist apprentice. He became night enginehouse foreman at Winslow, Ariz., on October 29, 1913, and general foreman at Winslow on August 21, 1916. He then served in the United States Army from May 26, 1918, until July 31, 1919. He returned to the Santa Fe on August 23, 1919, as division foreman at Gallup, N. M. On November 23, 1924, he was appointed master mechanic at Slaton, Tex.; on November 1, 1930, master mechanic at Clovis, N. M.; on April 19, 1933, master mechanic at Amarillo, Tex., and on October 20, 1937, master mechanic again at Clovis. He became superintendent of shops at Albuquerque on June 1, 1939.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Lincoln Lens.—The Lincoln Electric Company, Cleveland, Ohio. Bulletin No. 359; "Protection of the Eyes for Welding with Lincoln Super-Visibility and High-Visibility Lens."

◆

Threading Machines.—Landis Machine Company, Waynesboro, Pa. Sixteen-page bulletin, No. H-74-4, descriptive of Landmaco threading machines.

◆

Nathan Lubricators.—Nathan Manufacturing Company, 250 Park avenue, New York. Bulletins in loose-leaf form descriptive of various types of Nathan mechanical lubricators.

◆

Oakite Products.—Oakite Products, Inc., 22 Thames street, New York. 48-page, thirtieth anniversary booklet portraying production cleaning and its related operations in numerous fields, including the railroad industry.

◆

"Nickel Alloys in Railway Equipment."—The International Nickel Company, Inc., 67 Wall street, New York. Twelve-page illustrated booklet descriptive of the properties of nickel steels and other alloys of nickel used in the construction of steam locomotives, freight and passenger cars, and lightweight trains.

◆

Journal Boxes.—Hyatt Bearings Division, General Motors Sales Corporation, Harrison, N. J. Forty-eight page illustrated catalog descriptive of the Hyatt roller-bearing journal box, the Hyatt railroad roller bearing, and Hyatt journal boxes and bearings, Types J, K, and E.

◆

Pipe Machines.—The Oster Manufacturing Co., Cleveland, Ohio. 2057 East Sixty-First Place, Catalog No. 39-A. Contains time studies, threading speeds, specifications and descriptions of Oster-Williams hand tools and portable pipe machines.

◆

Standard Tools.—The Gisholt Machine Company, Madison, Wis. Forty-page catalog, "The Gisholt Standard Tools for Numbers 3, 4 and 5 Ram-Type Universal Turret Lathes," describes an extensive line of tools, including holding devices, boring bars and reamers and shows how they are adapted to a wide range of work on Gisholt Universal high-production and heavy-duty turret lathes.

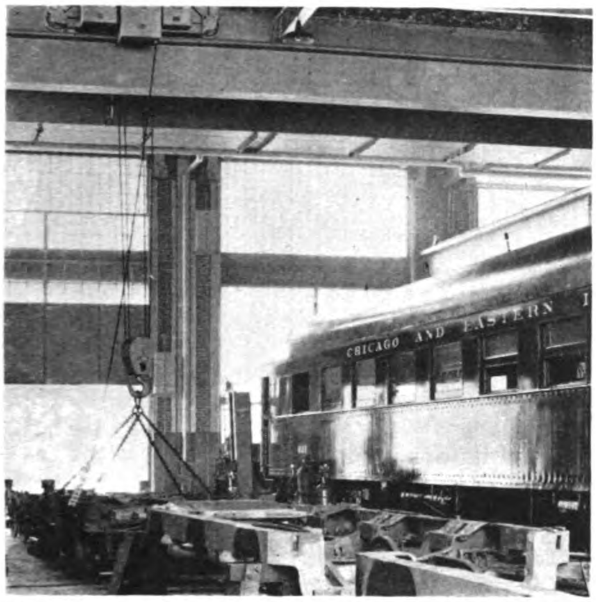
◆

Locomotive Equipment.—Wilson Engineering Corporation, 122 So. Michigan avenue, Chicago. Sixteen-page Locomotive Equipment Bulletin No. B-1. A general description and part lists of the following products and appliances: Feed-water heater and water conditioner, general service centrifugal pump, heat booster, air compressor radiation, terminal blow-down separator, blow-off mufflers and separators, blow-off cocks and sludge remover. Lists 73 railroads on which all or part of this equipment is now in use.

RAILWAY MECHANICAL ENGINEER

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office.



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September, 1939

Volume 113 *No. 9*

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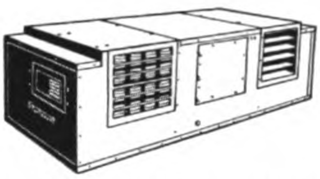
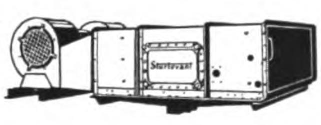
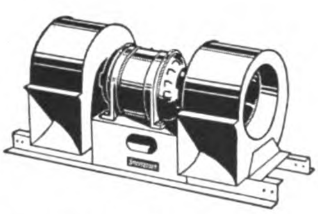

Sturtevant Air Conditioning Unit


Sturtevant Spray Washer Unit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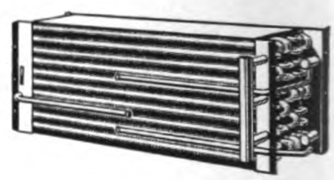
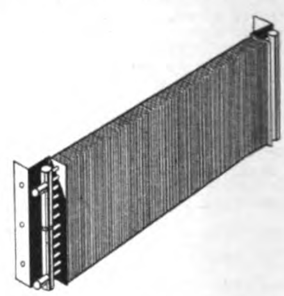
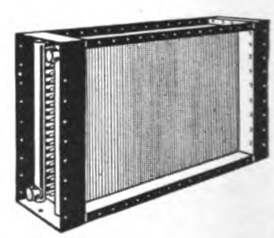

Sturtevant Freon Evaporator


Sturtevant Heating Coil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RAILWAY
MECHANICAL ENGINEER

French Tests Show

High Locomotive Efficiencies

By Lawford H. Fry*

Attention to details of design makes it possible for 120-ton four-cylinder compound locomotive to develop 3,700 i. hp. with a water rate of 13 lb. per horsepower hour

THE present article calls attention to the remarkable work which has been done by the French railways in the last ten years in developing the efficiency of the steam locomotive. A detailed account of this work forms an important part of André Chapelon's book on the Steam Locomotive.† The advances made can be summed up by the statement that the Paris-Orleans-Midi Railway started with a reasonably efficient Pacific type locomotive weighing about 220,000 lb. and giving about 2,200 i. hp. and by improving the boiler and the superheater and by the redesign of the cylinders, a 4-8-0 locomotive was evolved which developed about 3,700 i. hp. with an increase in weight of only about 20,000 lb. This is so striking that it is worth very careful consideration by American locomotive engineers.

The present article offers information as to the results obtained with the reconstructed locomotive and attempts to set forth the information in logical form. The values quoted have been obtained from an extensive array of test data reported by Mr. André Chapelon, equipment engineer of the Paris-Orleans-Midi, in a series of articles which appeared in the Revue Generale des Chemin de Fer for February and March, 1935. The greater part of the test data was obtained in road tests, the test train consisting of one or more brake locomotives running in reverse gear with the cylinders acting as air compressors. The resistance of these brake locomotives can be varied by altering the cut-off, so that the drawbar pull on the locomotive being tested can be kept constant in spite of variations in grades. In this way the effect of the profile of the road can be eliminated and the test locomotive can be run continuously at constant speed and cut-off.

Design of Test Locomotives

The locomotives tested were four-cylinder compounds with poppet valves, Serve ribbed flues, and Houlet superheaters. They were of the 4-8-0 type, rebuilt from the earlier four-cylinder compound Pacifics. It is not possible here to quote all of the voluminous test data or Mr. Chapelon's illuminating discussion of it. The original will repay careful study. Several locomotives were tested, the designs varying slightly. The dimensions given in the accompanying table are those finally adopted as most satisfactory. The tests now discussed were not always made with locomotives having all of the dimensions given, but the boiler test figures were obtained from boilers of the dimensions quoted and similarly for the cylinders. In presenting the results here, no further attempt is made to show that boiler and cylinder tests do not necessarily come from the same machine.

In its final design the locomotive is a four-cylinded compound 4-8-0 type, rebuilt from an earlier Pacific type. The trailer axle of the Pacific type was replaced by a fourth driving axle to provide adequate adhesion on heavy grades with poor rail conditions. The use of this fourth pair of drivers led to a narrow firebox placed between the wheels. The grate has a width of 3 ft. 3 in. so that to secure the desired grate area of 40.5 sq. ft., a length of 12 ft. 5 in. was necessary. Mr. Chapelon says that in spite of its unusual length the firebox can be fired by hand without serious difficulty. This view is borne out by the fact that maximum firing rates of over 200 lb. of coal per sq. ft. of grate per hour were reached.

The flue bundle comprises 28 1¾-in. tubes, 30 5¼-in. flues carrying Houlet superheater pipes, and 86 Serve ribbed flues 2⁹⁄₁₆ in. outside diameter. The length between tube sheets is only 13 ft. 11¼ in. but this short flue length is offset by the fact that the flues have a high ratio of gas swept perimeter to fire area, and the efficiency of the flues in absorbing heat is satisfactory. The firebox is fitted with a Nicholson thermic syphon. The working steam pressure is 285 lb. per sq. in. The feed water is supplied by an ACFI feedwater heater and by one non-lifting injector.

The steam and exhaust passages in the cylinders were designed to provide ample areas and a free flow for the steam. Mr. Chapelon points out that it is normal practice to give the steam passages an area equal to about one-tenth of the area of the piston. In the rebuilt locomotives the steam passage area was increased to about one-fifth of the area of the piston. As a result the steam-pressure losses due to wire-drawing are exceptionally low. Distribution of steam to the cylinders is effected

* Railway engineer, Edgewater Steel Company, Pittsburgh, Pa.
† Reviewed in the December, 1938, and January, 1939, issues of the *Railway Mechanical Engineer*, pages 473 and 1, respectively.

by poppet valves with oscillating cams driven by Walschaert valve gear.

The exhaust nozzle is of the double Kylchap type with two stacks. Particular attention was given to the drafting to secure adequate draft with minimum back pressure in the cylinders.

General Dimensions, Weights and Proportions of the Paris-Orleans-Midi 4-8-0 Type Locomotive

Railroad	Paris-Orleans-Midi
Type of locomotive	4-8-0
Weights in working order, lb:	
On drivers	168,000
On front truck	72,000
Total engine	240,000
Driving wheels, diameter outside tires, in.	72
Engine:	
Cylinders, number, diameter and stroke, in.:	
High pressure	2 – 17.3 × 25.6
Low pressure	2 – 25.2 × 25.6
Valve gear, type	Walschaert
Valves	Poppet
Boiler:	
Steam pressure, lb. per sq. in.	285
Thermic syphons, number	One
Plain tubes, number and diameter, in.	28 – 1.75
Serve tubes, number and diameter, in.	86 – 2.56
Flues, number and diameter, in.	133 – 5.24
Length over tube sheets, ft. and in.	13 – 11
Net gas area through tubes and flues, sq. ft.	5.32
Grate area, sq. ft.	40.5
Heating surfaces, sq. ft.:	
Evaporative, total	2,300
Superheating	722
General data, estimated:	
Rated tractive force, engine, lb.*	35,900
Factor of adhesion	4.68
Boiler proportions:	
Superheat surface, per cent evap. h. s.	31.4
Evap. heat surface ÷ grate area	56.8

* Rated tractive force is an arbitrary figure to represent the maximum cylinder effort exertable at the rim of the driving wheels at low speed. It is computed by assuming that the percentage of the boiler pressure available as mean effective pressure is 0.67 per cent in the high- and 0.25 per cent in the low-pressure cylinders.

Boiler Test Results

The original French text covers a very wide range of test data. For the present purpose the most significant data is translated into English units.

The relation between rate of firing, rate of evaporation, and boiler efficiency is shown in Fig. 1. The fuel used was a mixture of 60 per cent coal and 40 per cent of briquettes having a combined proximate analysis as follows: volatile matter, 19.0 per cent; moisture, 2.0 per cent; ash, 6.0 per cent, and heating value, 14,850 B.t.u. per lb. The firing rate was carried up to the high value of 245 lb. per sq. ft. per hr., so that it is evident that the coal was of excellent quality and well adapted for use in a locomotive firebox. In selecting a coal for this class of service the analysis and the heating value do not tell the whole story. It is essential that the coal stay on the grate in spite of the vigorous forced draft, and this requires a coal which cokes well. Mr. Chapelon calls attention to this and points out that no standard method has been adopted for measuring this important quality of the coal. The point is worth further study. Information developed during the tests of the Paris-Orleans locomotives shows that differences in coals which are not distinguishable by the usual tests for composition and heating value may have a considerable effect on the efficiency of combustion in a locomotive firebox. For the French tests two coals designated as *A* and *B* were available. The only difference between them was that *B* had been in the stock pile longer. Analyses and heating value were practically identical, but owing to the loss of coking power during stocking the *A* coal gave considerably less efficiency in the locomotive firebox. This is shown by the difference between the lines *A* and *B* in Fig. 1. At a firing rate of 145 lb. per sq. ft. of grate the boiler efficiency was 69 per cent with coal *B* and only 63 per cent with coal *A*. The explanation given is that the coal *B*, because of its better coking quality, formed a solid spongy mass on the grate. Although this gave a denser firebed requiring a greater smokebox draft than coal *A*, the scrubbing action of the air in the pores of the mass gave more intimate contact and better combustion.

Fig. 1 shows that the boiler could be driven to a firing rate of 245 lbs. per sq. ft. of grate per hour, a total of 9,900 lb. of coal per hour, giving an evaporation of 52,000 lb. of water per hour.

No information is available as to the weight of air utilized in combustion. Mr. Chapelon, unfortunately, does not accept the method used in this country for computing a heat balance from gas analyses, and no gas analyses are reported, nor are any definite figures given for smokebox temperatures. In the absence of this data it is not possible to break down the over-all boiler efficiency into its component parts, efficiency of combustion and efficiency of heat absorption. This would have been of particular interest because of the shortness of the flues which are less than 14 ft. long and the use of the Serve flues with longitudinal internal ribs increasing the flue surface in contact with the gases. This gives a high ratio of gas swept perimeter to area and increases the heat absorbing efficiency.

The over-all boiler efficiency of 61 per cent with a firing rate of 200 lb. per sq. ft. of grate per hour compares favorably with current American practice, but it seems probable that this is largely due to a relatively high efficiency of combustion made possible by the excellent quality of the coal used.

Values for the smokebox draft in relation to the rate at which steam is produced and exhausted are shown by the curves in the left-hand panel of Fig. 2. For comparison a line is drawn to represent typical American practice. Fig. 2 serves a triple purpose. The curves in the right-hand half show the relation between smokebox draft and back pressure, while the curves in the left-hand half show the relation between rate of steam discharge and back pressure. By projection across as in the line

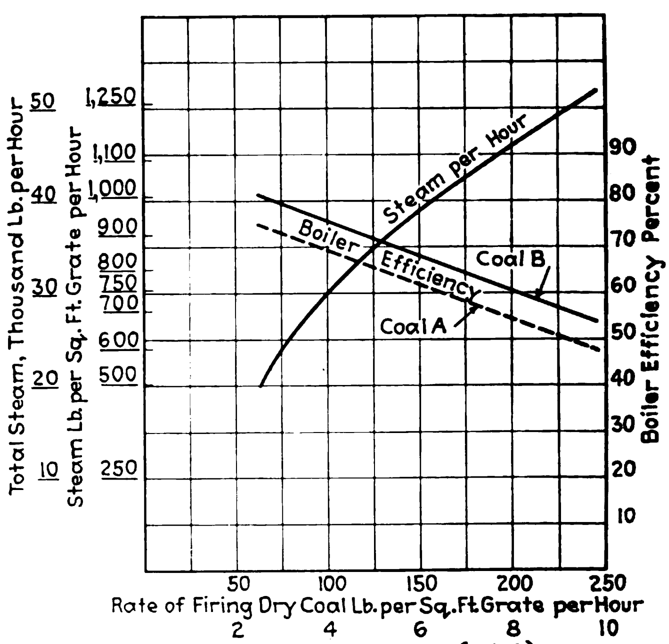


Fig. 1—Relation between rate of firing, rate of evaporation, and boiler efficiency

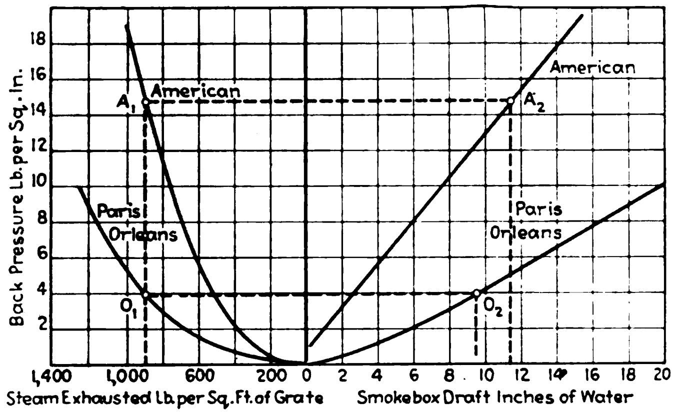


Fig. 2—Relation between rate of steam discharge and back pressure and between smokebox draft and back pressure

O_1O_2, the relation between steam production and draft is established. The dotted line O_1O_2 as drawn shows that the Paris-Orleans locomotive produces 900 lb. of steam per sq. ft. of grate per hour with a back pressure of 3.8 lb. per sq. in. and a smokebox draft of 9.4 in. of water. For comparison, curves representative of American practice have been drawn. The line showing the relation between back pressure and draft is that given in the 1936 report of the A. A. R. Committee on Locomotive Construction as typical. The values given are for draft back of the diaphragm, the curve showing the relation to steam exhausted. Using these curves it is seen from the line A_1A_2 that to produce 900 lb. of steam per sq. ft. of grate per hour in American practice a back pressure of about 14.8 lb. per. sq. in. might be expected with a smokebox draft of about 11.4 in. of water. From these figures it appears that the Paris-Orleans locomotive produces steam with a lower draft, 9.2 in. against 11.2 in., than is to be expected in American practice. The meaning of this cannot, however, be determined in the absence of information as to the rate at which air is supplied. Low draft values may be due to lower rates of air supply, or to less resistance to the flow of the air through the firebed or through the flues.

However this may be, it is important to notice the very low back pressure required to produce the draft. A draft of 11.2 inches of water back of the diaphragm requires a back pressure of 14.6 lb. per sq. in. according to the Locomotive Construction Committee curve, while the Paris-Orleans locomotive needs only 5.0 lb. per sq. in. The reduction of 9.6 lb. per. sq. in. means a very considerable gain in power. In a locomotive with cylinders 22½ in. by 29 in. with 79-in. drivers, this pressure represents a tractive force of 2,300 lb., or 460 hp., at 75 miles per hour. This reduction in cylinder loss would all be net gain at the tender drawbar and under the conditions indicated may represent 10 to 12 per cent increase in tender drawbar pull.

The possibility of such savings gives the Paris-Orleans front-end considerable importance. The arrangement comprises two exhaust nozzles with Kylchap distributors and two stacks. The two nozzles have a combined area of 31 sq. in., equivalent to a single nozzle of approximately 6⅝ in. diameter. The cylinders discharging steam through these nozzles have a diameter of 25.2 in., an area of 500 sq. in. each.

Each exhaust nozzle is set low in the smokebox, with four Goodfellow bars, and discharges into the bell mouth of a Kylchap distributor. This separates into four passages and discharges into a petticoat pipe which in turn discharges into the bell mouth of the stack near the top of the smokebox. Gases can be drawn in between nozzle and distributor, between distributor and petticoat pipe, and between petticoat pipe and stack. The two stacks have a combined area of 405 sq. in. at the throat, equivalent to a single stack of 22¾ in. diameter.

Cylinders Tests

The test data for the engine performance provides interesting food for thought. The use of the steam has been very carefully studied by the French designers and the result is a cylinder performance which ranks very high for power and efficiency. As shown in the table of dimensions, the engine is a compound with two high-pressure cylinders 17.3 in. by 25.6 in. and two low-pressure cylinders 25.2 in. by 25.6 in. Each pair of cylinders has an independent valve motion of the Walschaert type operating poppet valves.

In designing the engine, special attention has been given to:

(a) Delivering the steam to the high pressure cylinders with high superheat and the least possible drop below the working boiler pressure.

(b) Proper division of power development between the high- and low-pressure cylinders and delivery of steam from the high- to the low-pressure cylinders without undue loss.

(c) Exhaust of steam from the low-pressure cylinders with the least possible back pressure.

The work has been carried out so successfully that at 68 miles an hour in the range between 2,200 and 3,000 i. hp., the steam consumption is constant at 11.6 lb. per i. hp. hr. and even when pushed to the maximum of 3,200 hp. at this speed, the steam rate does not rise above 13 lb. per i. hp. hr. This high efficiency plays a large part in making it possible for a 120-ton locomotive to develop 3,700 hp., which is one hp. for 65 lb. of locomotive weight.

Delivery of Steam to Cylinders

The condition of the steam delivered to the cylinders in relation to rate of operation is shown is Fig. 3. The steam temperature is high, rising from about 715 deg. F. at a steam production of 20,000 lb. per hour to about 790 deg. F. at the maximum output of 50,000 lb. of steam per hour. One of the points in design emphasized by Mr. Chapelon as important is that these high tempera-

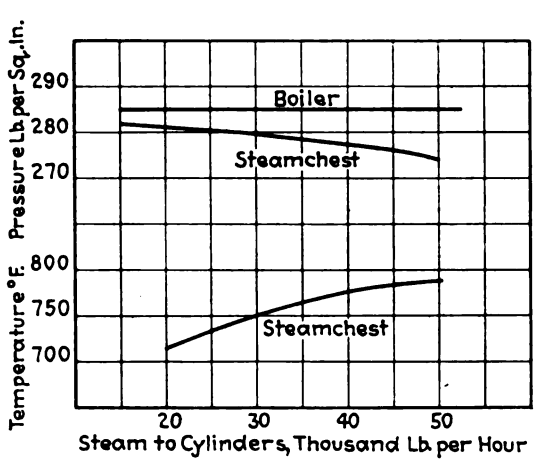


Fig. 3—The condition of the steam delivered to the cylinders in relation to the rate of steam consumption

tures are obtained with only a small drop in steam pressure between boiler and steam chest. With a boiler pressure of 285 lb. per sq. in. the steam chest pressure is not lower than 275 lb. per sq. in. at the maximum rate of 50,000 lb. of steam per hour. At the more normal working rate of 40,000 lb. of steam per hour the pressure

drop is only about 7 lb. per sq. in. These figures are about half of what might be expected in current American practice.

Reduction in the pressure drop between boiler and steam chest is of value on two counts. In the first place loss of pressure in the steam chest means a reduction in mean effective pressure. It has been shown above that avoidance of this loss may provide a very considerable gain in drawbar pull. In the second place a loss of pressure reduces the efficiency with which the steam can be expanded. Loss of steam pressure without work being done increases the entropy and therefore reduces the efficiency with which the steam can be expanded through a given range of pressure. Being an irreversible charge it allows the energy to go over into a form in which it cannot be utilized. The effect is very similar to that of friction when mechanical work is being done.

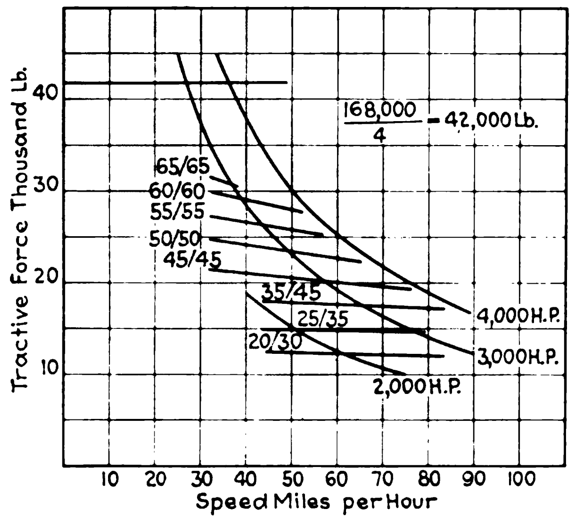


Fig. 4—Indicated cylinder tractive force in relation to speed

If all possible efficiency is to be obtained, the loss of pressure between boiler and admission ports must be reduced to a minimum. A point emphasized by Mr. Chapelon is that in order to prevent wire-drawing during admission the valve chest should have ample capacity. A volume at least equal to that of the high-pressure cylinder is recommended.

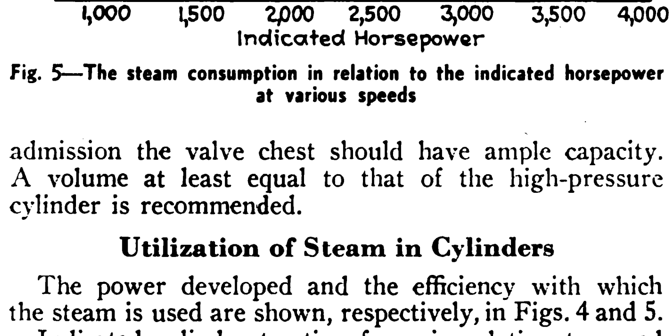


Fig. 5—The steam consumption in relation to the indicated horsepower at various speeds

Utilization of Steam in Cylinders

The power developed and the efficiency with which the steam is used are shown, respectively, in Figs. 4 and 5.

Indicated cylinder tractive force in relation to speed is shown in Fig. 4. The lines sloping down from left to right give the tractive force for various cut-offs. Each line is marked with the cut-off in high- and low-pressure cylinders. Attention is drawn particularly to the very slight falling off in tractive force as the speed is increased. At the shorter cut-offs there is practically no drop in tractive force as the speed increases. The steam flows freely through the cylinders at any speed and the horsepower increases in direct proportion to the amount of steam supplied. This is the result of reducing as far as possible resistance to steam flow in superheater and admission and exhaust passages.

Efficiency

The efficiency with which the steam is used in the cylinders is shown by the series of curves in Fig. 5. These plot the water per i. hp. hr. against i. hp. for various speeds. The values are low, showing high efficiencies through the range of operation. It is of particular interest to note the flatness of the curves showing, for each speed, only a moderate rise in water rate as the horsepower is increased by lengthening the cut-off. The curve for 68 m. p. h., 320 r. p. m., shows a water rate not over 12 lb. per hp. hr. for the range between 2,300 and 3,300 i. hp. Even when pushed to the maximum capacity of 3,700 hp. the water rate is only 13 lb. per hp. hr. Essential for high engine efficiency are, (a) that the steam carry adequate heat energy available for transformation into mechanical work, and (b) that the cylinders provide a high ratio of expansion to effect this transformation. In the Paris-Orleans locomotive the available heat energy is supplied by steam-chest pressures of 280 to 275 lb. per sq. in. and temperatures of 720 deg. F. to 780 deg. F. The opportunity for high rates of expansion is afforded by the use of compound cylinders. The high-pressure cylinders are 17.3 in. by 25.6 in., and the low pressure 25.2 in. by 25.6 in. giving a volumetric ratio of 1 to 2.12. With a cut-off of 25 per cent in the high-pressure cylinder, this gives an expansion ratio corresponding to a cut-off of about 12 per cent in a single-expansion cylinder.

The cylinder efficiency depends on having a high ratio of expansion such as this, but apart from the mechanical difficulty, the efficiency would not be so high if carried out in a single cylinder. The temperature drop between steam chest and exhaust is approximately 475 deg. F. This variation in a single cylinder would give rise to considerable cylinder-wall action reducing the efficiency. By dividing the expansion between two cylinders, the temperature range is practically halved with a corresponding improvement in cylinder efficiency.

In reporting the results obtained with the Paris-Orleans locomotive, Mr. Chapelon notes that at maximum power the i. hp., 3,700 to 4,000, is practically the same as the New York Central J1a. The Paris-Orleans locomotive is of the 4-8-0 type with 40.5 sq. ft. of grate. It weighs 240,000 lb. total with 168,000 lb. on drivers. The J1a, of the 4-6-4 type, has 81.4 sq. ft. of grate and a total weight of 340,000 lb. with 182,000 lb. on drivers. At the same speeds and cylinder horsepowers the lighter locomotive will be able to deliver considerably greater power at the tender drawbar.

Conclusion

This demonstration of locomotive efficiency obtained by attention to details of design offers a challenge to American locomotive engineers. High speeds are being demanded, and for high speeds, reduction in locomotive weight is of the first importance. The Paris-Orleans results raise a question as to the gains that might be made by the use of an improved front end and high boiler

(*Continued on page 352*)

Steam Locomotive

Poppet Valve Gear

Franklin system for use in America provides separate intake and exhaust-valve events —Each set of valves is driven by an oscillating cam—Both are controlled by a single reverse gear

For the past two years the Franklin Railway Supply Company, New York, has had under development a poppet-valve application and oscillating-cam driving mechanism which permits the separation of the control of the admission and cut-off events from that of the release and compression events. This has previously been possible only with the rotary-cam type of drive. Two oscillating cam shafts are employed, one for the intake valves and the other for the exhaust valves. The valve events are subject to control in practically unlimited steps by a single reverse mechanism. The functions of the cam-shaft driving mechanism are analogous to those of a Walschaert valve motion, with separate links for the intake- and exhaust-valve cams. A reverse mechanism controls the differential movements of the two sets of link blocks to permit practicable working at cut-offs much shorter than can be utilized with a piston valve or with poppet valves controlled by a single oscillating cam shaft.

There are three major parts to the Franklin device—the gear box, which contains the valve motion for driving the cam shafts, including the reverse mechanism; the cam box, and the steam chests over the ends of the cylinders in which the poppet valves are installed. The valve installation and cam box follow, in principle and in detail, the developments of the Societe d'Exploitation des Procedes Dabeg on the Continent of Europe and Associated Locomotive Equipment, Ltd., in England. The valve motion is entirely new. It has been developed in collaboration with the engineers of the Lima Locomotive Works, Inc.

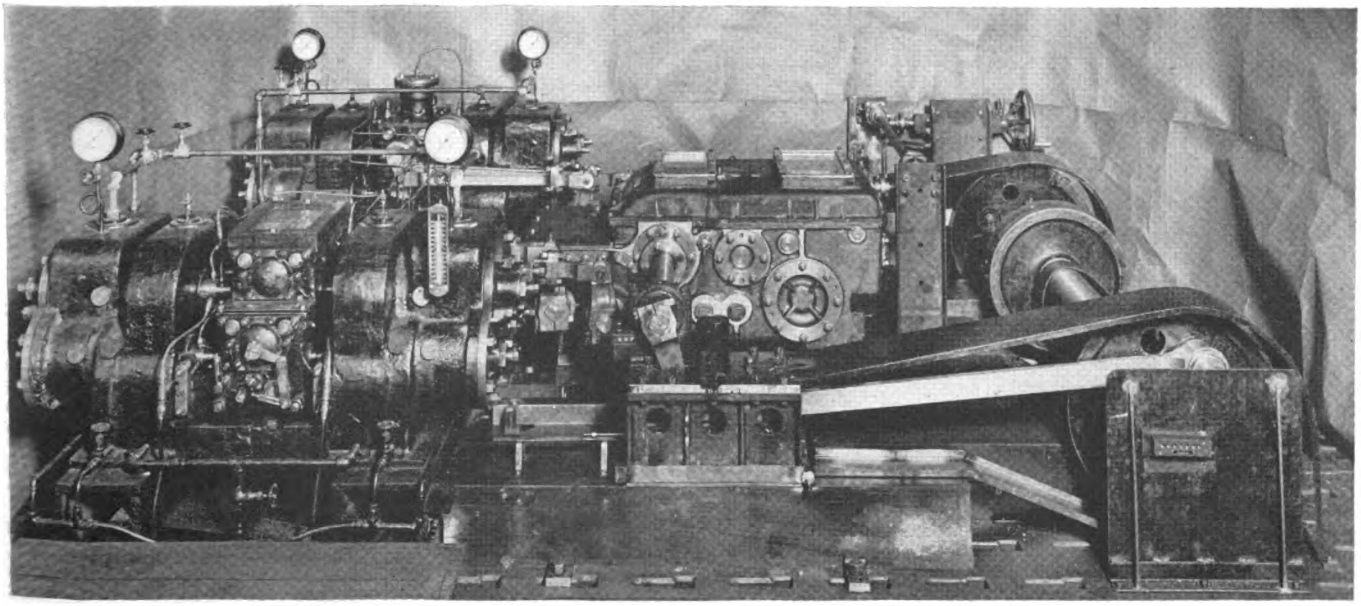
The Cam Box

A cam box is placed on top of each cylinder between the two steam chests, which are located over the ports of the cylinder. It contains two oscillating cam shafts, that on the top for operating the intake valves and that at the bottom for operating the exhaust valves. Instead of a single valve each for intake and exhaust, there are two intake and two exhaust valves. In this way the valves are kept small and light. The small valves are easily ground and kept steam-tight and their grouping around the port results in small cylinder clearance. For instance, on the 27-in. by 28-in. cylinder, the intake valves are 6 in. in diameter and the exhaust valves 7 in. in diameter, and the cylinder clearance is 8.4 per cent, although the port openings are considerably larger than in a conventional cylinder. The steam chests in which the valves are installed are cast integral with the cylinder.

Valve spindles extend through the inner wall of the steam chest and the springs which return the valves and spindles to closed position are located in sleeve caps secured to the steam-chest heads. The intake chamber proper is on the outside of the port and the exhaust cavity on the inner side, next to the cam box. The cam-box tappets line up with the ends of valve spindles. The maximum valve lift is 1 in. The cam box is lubricated by an oil pump driven from one of the cam shafts.

The Gear Box

The gear box is 55⅜ in. long by 32¾ in. wide, and 24⅝ in. high. It contains the complete valve motion



Side view of the test plant after the installation of the redesigned gear box

Comparison of Valve Events of Piston Valve with Walschaert Motion and the Franklin Steam Distribution System with Oscillating-Cam Poppet Valves

Cylinders, 21¼ in. by 26 in.; piston valve, 12 in. diameter; maximum travel, 7½ in.; poppet valves—two intake, 5½ in. diameter; two exhaust, 6 in. diameter.

	Pre-admission, per cent		Release, per cent		Compression, per cent		Max. Port Area at the Valves, sq. in. — Admission		Max. Port Area at the Valves, sq. in. — Exhaust †	
Cut-off, per cent	Piston valves	Poppet valves	Piston valves	Poppet valves	Piston valves	Poppet valves	Piston valves	Poppet valves	Piston valves	Poppet valves
Min. 7.26	7.26*	7.26	44.1*	83.8	44.1*	24.0	9.59*	16.9	63.3*	48.4
10.00	5.20*	5.20	48.7*	85.5	39.9*	21.5	9.76*	18.0	63.3*	48.4
15.00	3.33*	3.33	54.7*	87.5	34.2*	18.9	11.05*	20.2	63.3*	48.4
20.00	2.46*	2.46	59.6*	88.9	29.9*	17.1	12.73*	24.6	63.3*	48.4
25.00	1.80	1.80	63.9	89.9	26.2	15.6	14.99	28.3	63.3	48.4
30.00	1.47	1.47	67.6	90.6	23.2	14.4	17.40	33.3	63.3	48.4
35.00	1.20	1.20	70.7	91.3	20.8	13.5	20.40	36.8	63.3	48.4
40.00	1.00	1.00	73.7	92.3	18.4	12.1	23.02	39.8	63.3	48.4
50.00	0.67	0.67	78.9	93.4	14.3	10.3	30.8	39.8	63.3	48.4
60.00	0.53	0.53	83.7	94.4	10.9	9.2	41.3	39.8	63.3	48.4
Max. 70.4	0.33	0.33	88.4	95.8	7.6	6.7	57.5	39.8	63.3	48.4

* With piston valves cut-offs below 25 per cent are impracticable in operation. The figures indicate the kinematics of the Walschaert valve motion, although, in practice, cut-offs less than 25 per cent are impracticable.

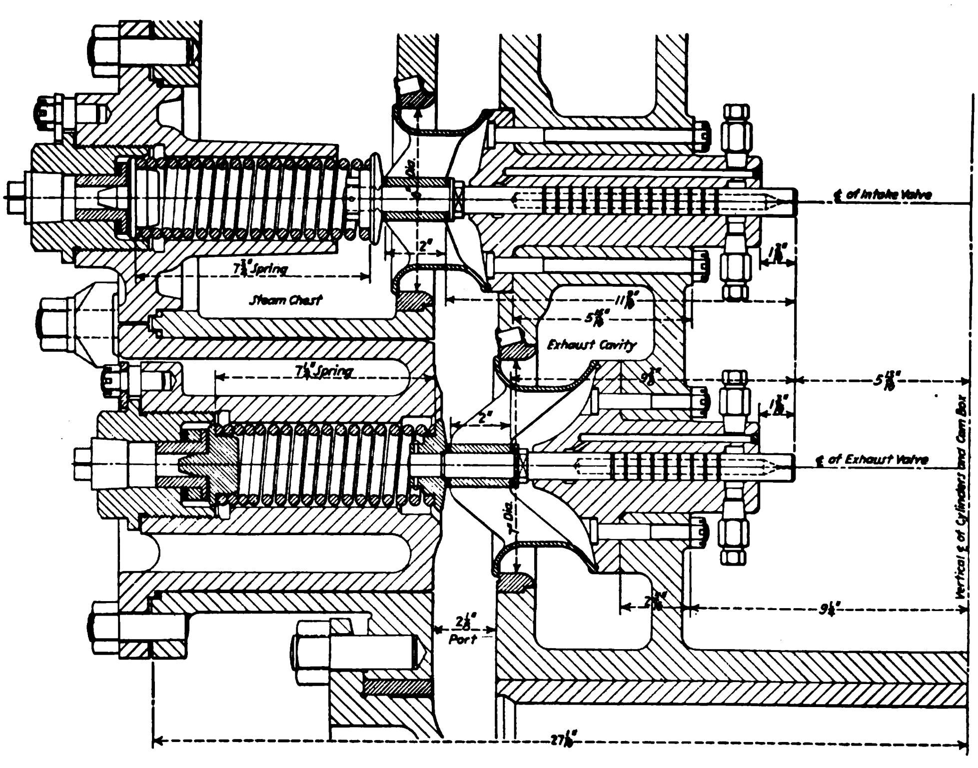
† The areas shown are those through the valve-bushing ports in the case of the piston valve and the areas through the valves in the case of the poppet valves. Actual admission to the cylinders is limited by the area of the port through the cylinder bushing. These are, respectively, 37.9 sq. in. for the piston-valve locomotive and 38.72 sq. in. for the poppet-valve locomotive.

which operates independently the intake and exhaust cams for both cylinders of the locomotive. It may be located between the frames immediately back of the cylinders, or on the deck in front of the cylinders.

The gear box is driven from the two crossheads through union links attached to arms on the ends of the two drive shafts, which enter the box one on each side. Each drive shaft, therefore, oscillates in unison with the crosshead on its side, and the oscillating motions on the right- and left-hand sides are, of course, in 90-deg. phase. In the gear box, these two oscillating motions are combined by means of radial links and combining levers into four oscillating motions, two for the intake-cam motions and two for the exhaust-cam motions. The radial links and combining levers perform much the same function as the Walschaert gear links and combining levers. However, in the gear box there are two radial links for intake motion and two radial links for exhaust motion, and these links are mounted in pairs, both the intake link and the exhaust link of each pair moving in unison. The radial links for the valve motions on one side of the locomotive are derived from the oscillating shaft driven by the crosshead on the opposite side of the locomotive, while the combining levers, one for each link, receive their motion from the oscillating shaft driven from the crosshead on the same side of the locomotive. The separation of the intake and exhaust motions is secured by a differential location of the respective link blocks in the links.

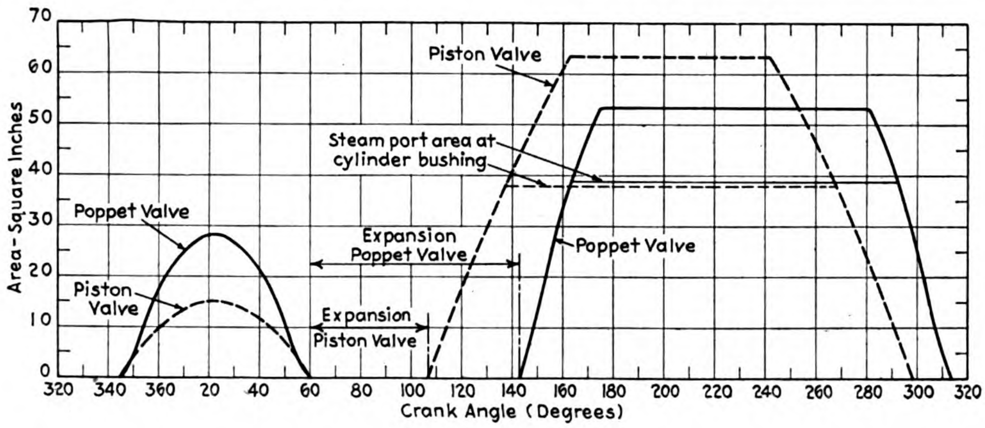
The Reverse Gear

The differential control of the intake and exhaust link blocks is by means of an interrupted gear arrangement which is operated from the reverse gear in the cab. This arrangement moves the link blocks differentially in such a way that when the intake link blocks are in the minimum cut-off position (mid-link), the exhaust link blocks are set approximately for 84 per cent release and 24 per cent compression. This may be called mid-gear for-



Details of the valve chamber and poppet-valve installation for a 27-in. by 28-in. cylinder

Comparison of the expansion and effective valve areas at 25 per cent cut-off on a 21¼-in. by 26-in. cylinder — The piston valve is 12-in. in diameter, the two intake poppet valves 5½-in. in diameter, and the two exhaust poppet valves 6 in. in diameter



ward position. At this point, the interrupted gear train continues to change the position of the exhaust link blocks and to hold the intake-link blocks stationary in the link until mid-gear reverse is reached, at which point the exhaust link blocks are set for approximately 84 per cent release and 24 per cent compression (reverse motion). From this point, both intake and exhaust blocks move differentially until full-gear reverse position is reached.

It will be noted that this provides a control at the cab reverse gear having a zone of movement from full-gear forward to mid-gear forward, a neutral zone from mid-gear forward to mid-gear reverse, and a reverse zone from mid-gear reverse to full-gear reverse. This has the advantage that the engineman can cut back to mid-gear forward with no fear of going into reverse because, should he slightly overrun his gear, no harm will result. Moreover, in the center of the neutral zone, provision is made for automatically cutting in the drifting arrangement, which lifts all the intake valves from their seats to full open position. Experience has shown that this provides ample areas between the ends of the cylinders, thus resulting in free drifting.

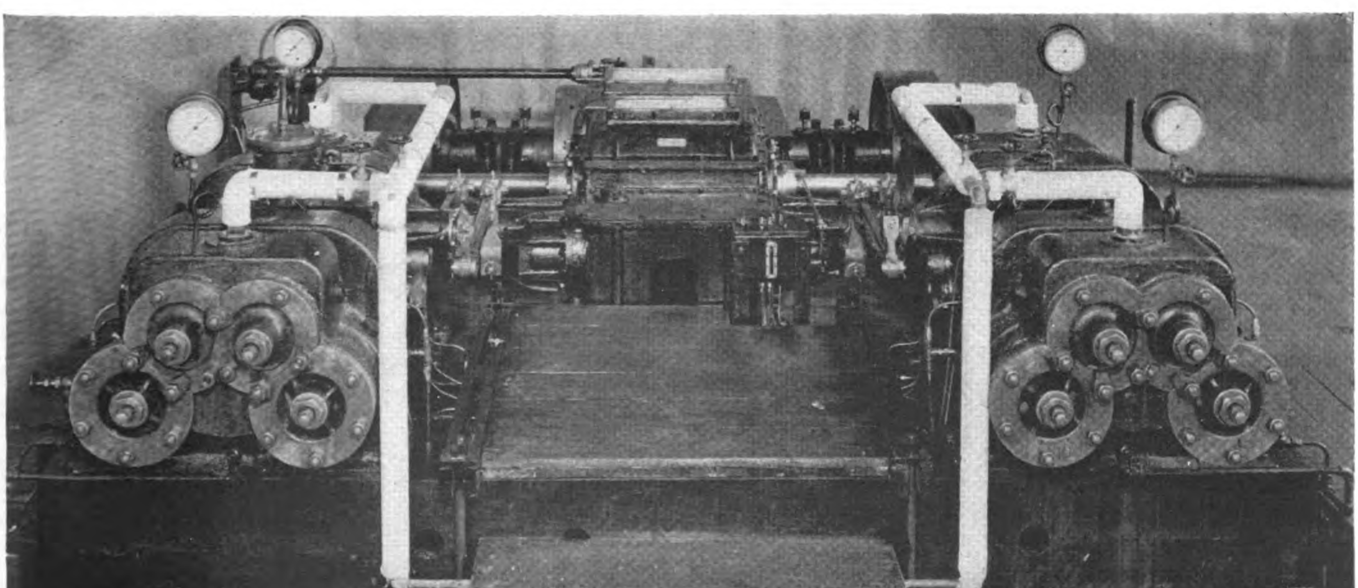
The gear box is completely enclosed and the parts operate in an oil bath. Needle bearings are installed throughout, including the roller link blocks. The total weight of the gear box is 3,600 lb. The cam box and the gear box are removed from, and replaced on the locomotive each as a complete assembly. For the purpose of proper valve-setting reference points on the cylinders, the gear box, and the cam boxes permits accurate adjustment of the lengths of gear-box and cam-box connecting rods by means of shims between the bodies of the rods and the stub ends.

Operating Characteristics

The separation of the release and compression events from the admission and cut-off events makes it possible to operate effectively at a minimum cut-off of 7.26 per cent. A comparison of the events produced by a Walschaert valve gear driving a 12-in. piston valve and by the Franklin gear with two 5½-in. admission valves and two 6½-in. exhaust valves, both operating on 21¼-in. by 26-in. cylinders, is shown in the table. This clearly indicates the effectiveness with which release and compression are delayed so that, at the 7.26-per cent cut-off, the release with the poppet valves is practically as late as at 60 per cent cut-off with the piston valve driven by the Walschaert gear, and compression compares with that of the piston valve at between 25 and 30 per cent cut-off.

This table also shows the greater maximum area through the intake valves throughout the entire range of cut-offs. The comparative effect of this in port area times the time available for the passage of steam is illustrated for the 25-per cent cut-off.

The relation between intake-valve events and release



Front view of the steam chests—The gear box occupies a position immediately behind the cylinder saddle which is not included in the laboratory installation

and compression events is not limited to the values shown in the table. The interrupted gear arrangement and the cams can readily be changed so that practically any desired relation between intake-valve events and release and compression events can be obtained.

Development of the Gear

In the development of this device a complete valve gear with cam boxes, full size castings of the steam-chest portions of the cylinders, and a complete installation of intake and exhaust valves was set up in the laboratory and operated by a motor-driven crank shaft and crossheads. After preliminary trials this equipment was operated 24 hours a day at a speed of 350 r. p. m., equivalent to 83 m. p. h., with 80-in. driving wheels and at times at speeds as high as 500 r. p. m. Except for shut-downs for examination, this was continued until an equivalent mileage, based in 80-in. drivers, of 155,000 had been accumulated.

Comparative sizes of poppet valves and 12-in piston valve—The two 6½-in. exhaust valves weigh 3 lb. 13 oz. and the 5½-in. intake valves, 2 lb. 12 oz. each—The piston valve weighs 132 lb.

During this intensive operation stroboscope studies showed clearly where undesirable flexure occurred at high speeds and, as a result, alterations in the design of parts were made to stiffen up the entire motion. Finally, a complete new gear box was designed involving all of the changes which the tests indicated desirable. The result has been that, operating at 500 r. p. m., there is no sign whatever of the slightest distortion or over-travel in the oscillating motion of the cams or in the movement of the valves themselves.

One of the inherent advantages of poppet valves is the small amount of power required to operate them. During the laboratory tests of the development set the horsepower required to operate the valve motion and the valves varied from 0.05 at 210 crankshaft r. p. m. to 3.30 at 500 crankshaft r. p. m. The power absorbed varies only with the speed and is not affected by changes in cut-off at a given speed. The Walschaert gear and piston valve absorbs as much as 50 hp. at 300 r. p. m. The small power consumption of the poppet-valve motion reflects the fact that its parts are produced by precision methods, that it is completely equipped with anti-friction bearings, and that it is thoroughly lubricated, as well as the fact that the driven parts are of light weight.

The conditions under which the gear box and the cam box and valves of the development set were operated are closely identical with the conditions encountered in actual locomotive operation, with the exception that the valves were not under pressure and passed no steam. Spring loading was added, however, to compensate for the unbalanced area of the valves.

In the tests of the first gear box approximately 90 per cent of the pins and bearings showed no appreciable wear after 155,000 miles and were in condition for further service. The remaining 10 per cent were replaced on account of design changes. All of the parts in the second gear box have covered 35,000 miles to date.

High Locomotive Efficiencies

(Continued from page 348)

pressure with the high ratio of expansion made possible by compound cylinders.

Compounding was widely used in this country some forty years ago, but disappeared from the picture for reasons not in any way connected with the principle. With the high- and low-pressure cylinders superposed and driving a common crosshead, obvious mechanical difficulties gave sufficient cause for discontinuance. The four-cylinder balanced compound was a better design. The only weak point was the crank axle. The space available between the frames is so narrow that there is no room for a crank axle with sufficient strength and enough bearing area for the main pins. In a locomotive with four outside cylinders, in the modern American style, this particular difficulty would be eliminated. Other difficulties would be encountered, but there is no reason to believe that they would be insurmountable.

High speeds are in demand, requiring greater power. Under these conditions, improved efficiency giving greater power without increase in weight is particularly desirable. At lower speeds it has been thought from time to time that the ceiling of power had been reached, but with further effort more power has been obtained by some increase in efficiency, but mainly by an increase in size.

For really high speeds, increase in efficiency becomes of the first importance. The inexorable opposition of mass to acceleration puts a premium on light weight for a high-speed locomotive.

Looking on from the sidelines, it seems to this observer that there is an opportunity for an American revival of compounding. A designer who would combine this with other opportunities for engine efficiency might go far in improving the already high standing of the reciprocating steam locomotive.

A HIGHWAY PASSENGER "TRAIN", 70 ft. in length and comprising two coupled units connected by a flexible passageway, has been introduced on an express motor highway between Berlin and Munich, Germany, via Dessau, Leipsig and Halle. Named the "Gaubschat" train after its inventor, the vehicle weighs 33,069 lb., is powered by a 150-hp. Diesel engine and has seating capacity for 78 passengers. The round-trip fare between its termini is quoted at 30 reichsmarks ($12), as compared with the cheapest rail rate of 40 reichsmarks ($16).

Lehigh and New England

Cement Hopper Cars

Cars built by American Car and Foundry Company of welded construction—They can be loaded to 78 tons and are capable of dumping this load in 22 min. —The capacity is 1,790 cu. ft.

With the recent delivery of 50 bulk cement cars with hatchway roofs and hopper bottoms the Lehigh & New England now has in service a total of 175 cars of this type, all built by the American Car and Foundry Company during the past two years.

These cars have contributed materially to an increase in the volume of cement traffic handled by the road. They have proved especially convenient for contractors using cement on large concrete projects, such as dams, highways, bridges, piers, etc., because of the ease and economy with which the cars can be loaded and unloaded.

This type of car is also adapted to the handling of other bulk commodities such as sand, lime, dolomite, carbon black, solid chemicals, paint pigment, wood flour, Fuller's earth, powdered coal, etc. With a lading of 400 barrels of cement per car, the cars can be unloaded into the ordinary track hopper in approximately 60 minutes and into the usual single-screw conveyor unloader in about two hours. In one instance, a car of this type was unloaded into a chute leading to a floating barge in 22 minutes using all four gates simultaneously. The amount of cement discharged in this instance was 78 short tons.

An outstanding feature of these cars is the use of fusion-welded butt joints wherever the lading comes into contact with the inside surfaces of the hopper sheets, thereby eliminating projections such as rivet heads, weld beads, or projections of any kind which tend to slow up or even stop the discharge of lading from a hopper. Further, to prevent any such happening, all weld beads in contact with the lading are ground off flush with the plate surface.

Cars Have Twin Hoppers

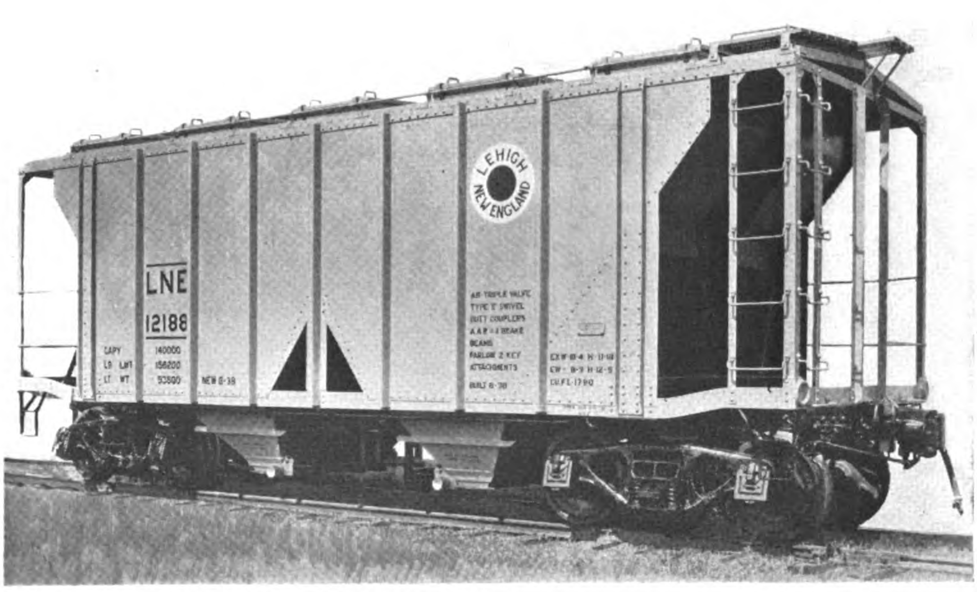
These cars are of the twin-hopper type with four sliding gate-valve type outlets and a roof with 10 watertight hatches for loading. The general design of the hoppers follows the typical construction of a coal hopper, except that this car has a center partition sheet across the car at the cross ridge, and the gate-valve type outlets. The material used is open-hearth steel, except that plates 1/4 in. and under are copper-bearing steel.

The end floor sheets and the outside hopper sheets slope at 50 deg. and the cross-ridge sheets slope at 60 deg. from the horizontal.

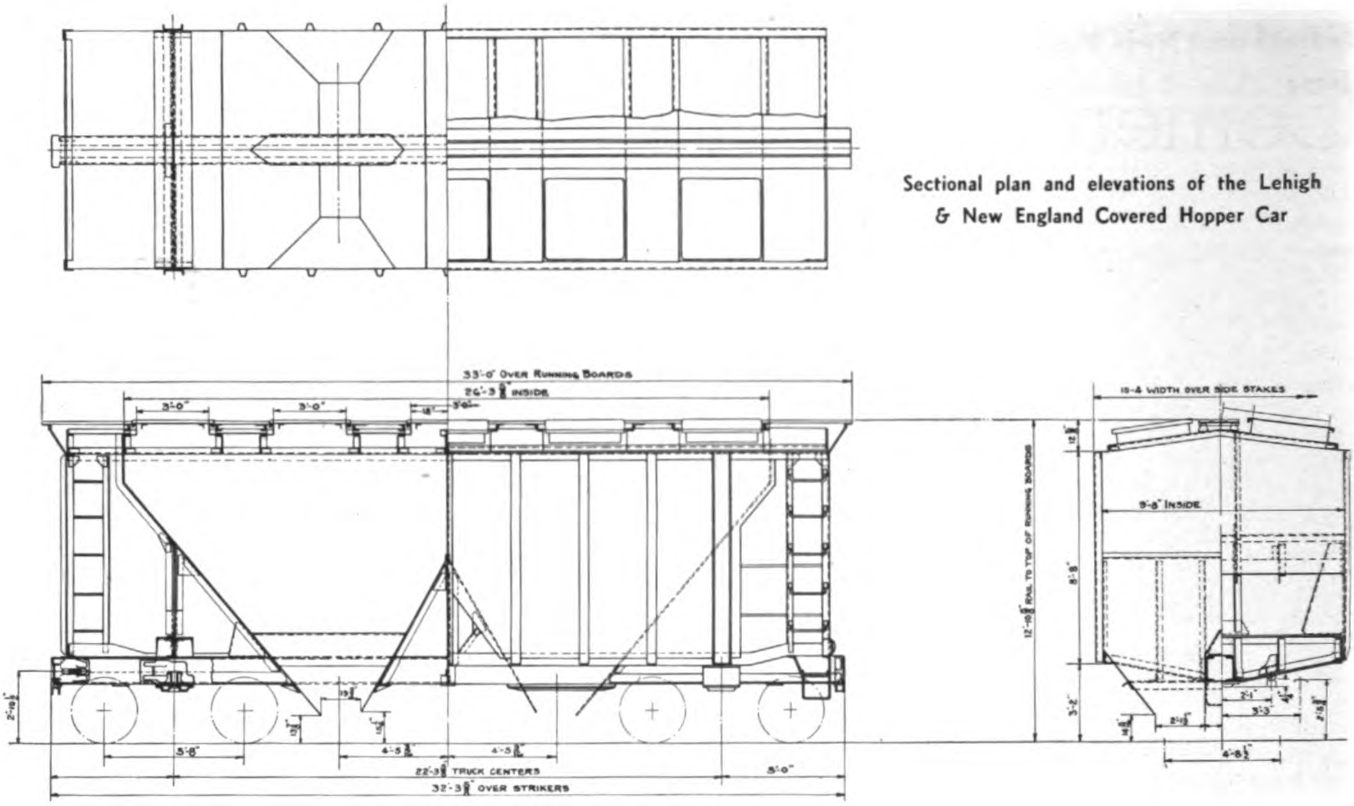
The side construction consists of 3/16-in. sheets; 6-in. by 3 1/2-in. by 3/8-in. side-sill angles and 4-in., 10.3-lb. Z side plates. The side posts are 5/16-in. U-shaped pressings welded to the outside of the side sheets. A 9-in. 15-lb. channel on the outside of the side sheets forms the

Principal Dimensions and Weights of L. & N. E. Cement Cars

Length over striking plates, ft.-in.	32– 3 5/8
Length inside, ft.-in.	26– 3 5/8
Width inside, ft.-in.	9– 8
Width overall, ft.-in.	10– 4
Height, rail to side plate, ft.-in.	11–10
Distance between truck centers, ft.-in.	22– 3 5/8
Truck journals, in.	6 × 11
Truck wheelbase, ft.-in.	5× 8
Light weight, lb.	53,800
Weight of car body, lb.	34,680
Weight of trucks, lb.	19,120
Load limit, lb.	156,200
Cubic capacity, cu. ft.	1,790



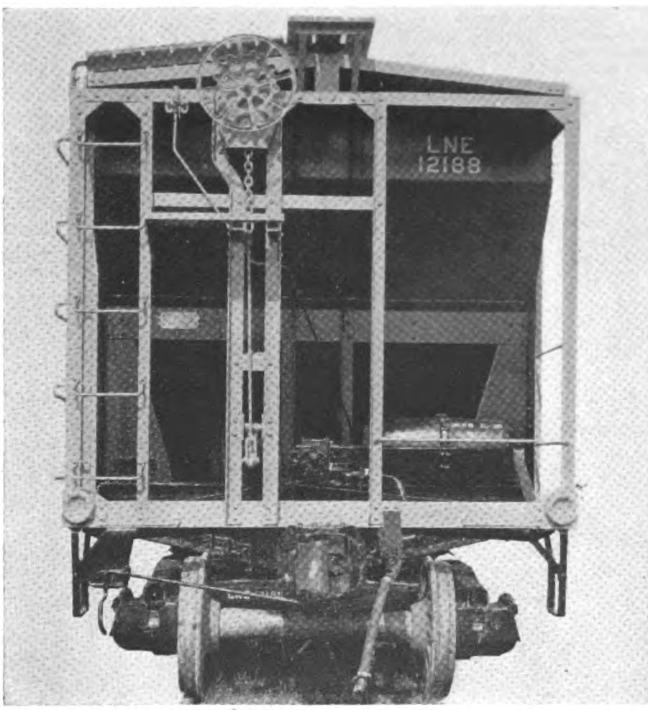
Lehigh & New England 70-ton cement car



Sectional plan and elevations of the Lehigh & New England Covered Hopper Car

bolster posts. The center sills consist of two, 13-in., 35-lb. channels with a 3/8-in. cover plate extending from striking casting to striking casting.

The bolster is of web-plate and chord-angle construction with top and bottom cover plates. The web plate



does not extend to the floor plate as in typical car construction. The end floor sheets are supported over the bolsters by vertical angles at the center, connected to the bolster, and extending to a 3/8-in. plate bent to fit the slope of the floor sheets and extending the full width of the car. This plate is further supported at the side by a large vertical 1/4-in. gusset plate extending to the top of the bolster and riveted to the bolster post forming a rigid construction at this point.

The end floor sheets are also supported and reinforced by angles extending from the roof down the slope of the sheets to the center of the sill in two pieces. They are welded to the floor sheets and riveted to the center sills and angles over the bolsters. Two intermediate angle stiffeners are welded to the underside of the floor sheets and extend from the 3/8-in. transverse plate stiffener to a point level with the center sill.

A 1/4-in.-plate longitudinal hood covers the center sills between the floor sheets and the cross-ridge sheets. All fabrication in the interior of the car, 3 in. below the eaves, is arc welded with welds finished to a smooth surface so as to prevent lading from adhering to it.

Ten Hatches in the Roof

The roof consists of No. 11 gage copper-bearing steel sheets riveted to angle carlines. Hatch door openings, 3 ft. by 3 ft., are spaced equally, five on each side of the longitudinal center line of the car. Hatch frames of 3/16-in. copper-bearing steel, 5 1/2 in. high, are provided with hinged covers of No. 11 gage copper-bearing steel. Asphaltum paper is applied to all roof joints to insure a water-tight roof. Hatch-door locking bars extend the full length of the car on each side. Each bar is locked at both ends of the car between two end doors with a seal-pin arrangement. The bars have sufficient tension in the arms to insure a door being held water-tight.

Enterprise cast-steel frames and gates are welded to each hopper outlet. The lowest point of the frame is 9 in. above the top of the rail.

The 70-ton trucks are A. A. R. double-truss type with cast-steel integral-box side frames and bolsters. They are fitted with coil-elliptic springs and chilled-iron car wheels. The cars are equipped with AB brakes furnished by Westinghouse. One of these cars is a part of the railroad exhibit at the New York World's Fair.

Double-Glazed Sash For Air-Conditioned Cars

One of the important problems in the building of air-conditioned cars is the construction of window sash. The double-glazed sash with the inner-compression seal, made by the O. M. Edwards Co., Inc., Syracuse, N. Y., has been designed to meet the primary requirements of an ideal sash for these cars.

In this sash the two panes of glass, set in metal frames, are spaced about ½ in. apart and are separated by two abutting, compressible, and removable rubber glazing strips. The principal reason for using two panes of glass in a window opening is to reduce the heat transfer, and the overall thermal conductivity for windows of normal size is reduced approximately 50 per cent by the use of double glazing. Previous to air-conditioning, double-glazing was only required during the winter to keep the outside cold air from chilling the inside warm area. With air-conditioned cars it is just as essential to keep the heat of the warm outside air from being transmitted to the interior, which is being cooled.

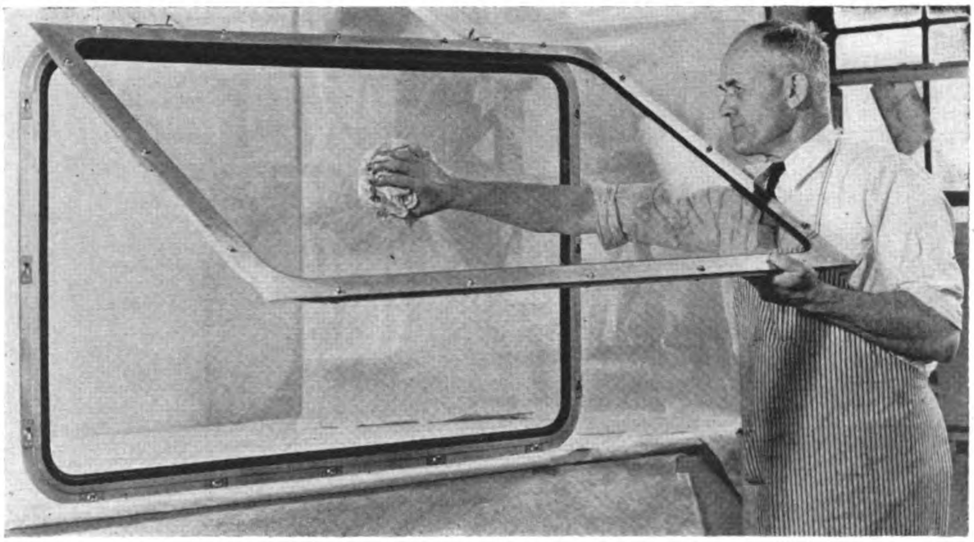
Another important consideration is the comfort of the passengers. In a coach with an inside temperature of 70 deg. F. and an outside temperature of 10 deg. F., the inside surface of a single-glazed sash would be 42 deg. F. with zero wind velocity, 22 deg. F. when the wind velocity is 30 m. p. h., and 19 deg. F. when the wind velocity is 60 m. p. h. It may readily be seen that a passenger sitting next to a single-glazed sash under such conditions would be very uncomfortable. In the same coach equipped with double-glazed sash and with an inside temperature of 70 deg. F. and an outside temperature of 10 deg. F., the inside surface of the inside pane would be 53 deg. F. with a zero wind velocity, 43 deg. F. when the wind velocity is 30 m. p. h., and 42 deg. F. with a wind velocity of 60 m. p. h. From the above comparison it is obvious that double glazing not only reduces heat transfer but is essential for maximum passenger comfort.

The inner sash of the Edwards double-glazed sash is compressed to the outer by a succession of ingenious, quarter-turn, spring-actuated "compressionizers" spaced around the sash, which maintain and equalize the pressure seal, thus creating the Edwards inner-compression seal. The amount of pressure provided by these compressionizers can be varied so that if each of ten of these devices exerts a 35-lb. pressure, there is 350 lb. of pressure constantly applied around the edges of the glass area.

This seal is important for insulation purposes and to prevent the infiltration of moist air and dirt particles. The essential job of insulation in the dead-air space between the panes of glass is done by the film of air that lies directly on the inside of the glass, like a skin. The reason for the dead-air space is to avoid disturbance of the air and the breaking of this protective film. The infiltration of the moist air inside the car would cause fogging or frosting of the glass. The fogging generally occurs during the colder months of the year; if the glass is cold enough the moisture forms frost.

The variation in the thickness of glass allowed by the Bureau of Standards is plus or minus $\frac{1}{32}$ in. To take up this variation a compressible seal must be used, and the best resilient sealing material at the present time is rubber. Rubber, however, allows the passage of water vapor through it, and with varying water-vapor pressure in the atmosphere, there will be a passage of moisture through the rubber to or from the dead-air space. In the Edwards sash, de-hydrating tubes, located within the dead-air space and independent of the sash structure, absorb this moisture and prevent fogging.

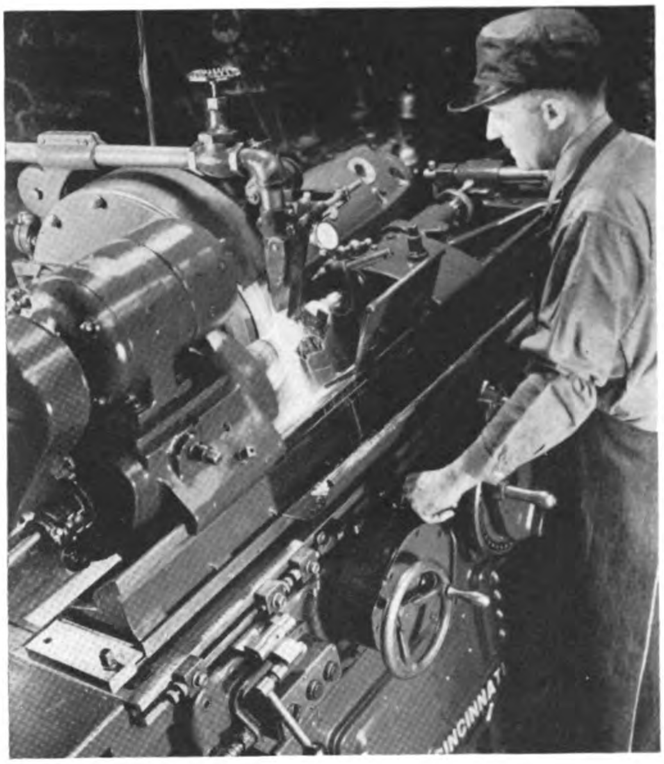
The inner sash of the Edwards double-glazed sash is suspended by hinges of the floating-pivot type which take the major portion of the weight when the window is opened, and the sash is easily opened by making a quarter-turn of the "compressionizers" with a screwdriver. This mounting facilitates the cleaning of the inside glass surface. Glass develops an oxide coating in time on its surface. This is called "scum" by the glass manufacturers and, if not cleaned off, it will eventually stain the glass so that it can only be removed by polishing. This condition occurs with silicon glass but not with the more expensive potash glass.



The Edwards double-glazed sash is easily opened for the cleaning of the inside glass surfaces

Provision has been made in the design of the Edwards double-glazed sash to insure its application to the car body in a true plane to prevent the transmission of vibration and weaving of the car to the sash, and to make certain of the seal between the sash frame and the car structure. This feature of the design may be altered in minor details to conform to varied car construction. The design is also suitable for meeting all requirements of designers for decorative effect.

1939 Machine Tool Show



THOSE executives and supervisors of the railroad industry who are responsible for the selection and purchase of machine tools and shop equipment are going to have the opportunity to look over the most extensive exhibit of modern shop tools and related accessories which has ever been assembled in any exposition in this country when they attend the 1939 Machine Tool Show at Cleveland Public Auditorium, October 4 to 13. This year's display will embrace the exhibits of over 200 manufacturers and will occupy 153,000 square feet of floor space —25 per cent more than that covered by the 1935 show.

The 1935 Show was well attended by railroad men, 62 roads having sent representatives to Cleveland. There is every reason for the attendance to be considerably greater at this year's Show for the reason that the machine tool industry is passing through one of the busiest periods in its history and the results of the intensive development work which has been done since 1935 are to be on display at Cleveland in October. Then too, over 60 per cent of the 200 companies exhibiting are manufacturers well known to railroad men.

One of the features of unusual interest will be the technical sessions of the Machine Tool Congress. At the several sessions, on seven evenings, many papers will be presented by men of prominence in industry that will provide an opportunity to get first-hand information on modern machine tools and their use. The program of these meetings appears on this page.

Program of the Machine Tool Congress

WEDNESDAY EVENING, OCTOBER 4

8:00 p. m.—National Electric Manufacturers Association, Hotel Cleveland Ball Room.

THURSDAY EVENING, OCTOBER 5

8:00 p. m.—American Society of Mechanical Engineers, Machine Shop Practice Division, Hotel Cleveland Ball Room.
Presiding Officer: A. G. Christie, Professor, Johns Hopkins University; president, A. S. M. E.
Cast Iron for Machine Tool Frames, by Frank Dost, Sterling Foundry Company, Wellington, Ohio.
Welded Frames for Machine Tools, by Fred Volz, Lakeside Bridge & Steel Company, Milwaukee, Wis.

8:00 p. m.—American Society of Tool Engineers, Inc., Cleveland Engineering Society quarters, Guildhall.
Presiding Officer: G. J. Hawkey, chairman, Cleveland Chapter, A. S. T. E.
Application and Use of Anti-Friction Bearings as Applied to Machine Tools, by Stanley R. Thomas, chief engineer, Bantam Bearings Corporation, South Bend, Ind.
Application and Use of Plain Bearings as Applied to Machine Tools, by Eugene Bouton, supervisor time study, J. I. Case Tractor Works, Racine, Wis.
Bearings—Their Use and Misuse, by Karl L. Hermann, engineer, South Bend, Ind.

7:30 to 10:00 p. m.—General Electric Institute open house program and lighting demonstration, Nela Park.

FRIDAY EVENING, OCTOBER 6

6:30 p. m.—American Society of Tool Engineers, Inc., dinner meeting, Hotel Statler Ball Room.
Presiding Officer: James R. Weaver, president, A. S. T. E.
Second report of Fact Finding Committee on Effect of the Development of the Machine on Employment and Our Standard of Living, by John R. Younger, professor, Department of Industrial Engineering, Ohio State University; chairman, Fact Finding Committee.
Economic and Political Effect of the Development of the Machine, by Hon. Hamilton Fish, United States Congressman from New York.

8:00 p. m.—National Association of Foremen, Music Hall, Cleveland Public Auditorium.
Presiding Officer: C. R. Hook, president, American Rolling Mill Company.
Streamlined Supervision, by Capt. A. A. Nichoson, personnel director, The Texas Company, New York.
A. C. Horrocks, Goodyear Tire & Rubber Company, Akron Ohio; and Executive Vice-President, N. A. F.

MONDAY EVENING, OCTOBER 9

6:30 p. m.—American Foundrymen's Association, Inc., dinner meeting, Hotel Hollenden Ball Room.
Presiding Officer: F. F. Hess, metallurgical engineer, Ohio Injector Company and president, Cleveland Chapter.

8:00 p. m.—Symposium on Castings, Hotel Hollenden Ball Room.
Dr. H. A. Schwartz, National Malleable & Steel Castings Company, Cleveland, Ohio;
James Thompson, chief engineer, Continental Roll & Steel Foundry Company, East Chicago, Ind.; chairman, Foundry Practice Committee, A. S. M. E.;
A. C. Denison, president, Fulton Foundry & Machine Company, Cleveland, Ohio; chairman, Research Committee, Meehanite Research Institute.

6:30 p. m.—Associated Machine Tool Dealers of America, dinner meeting, Hotel Cleveland Ball Room.

TUESDAY EVENING, OCTOBER 10

8:00 p. m.—Cleveland Engineering Society, Machine Design Division, Music Hall, Cleveland Public Auditorium.

WEDNESDAY EVENING, OCTOBER 11

6:30 p. m.—Society of Automotive Engineers, Inc., dinner meeting, Hotel Cleveland Ball Room.
Presiding Officer: W. J. Davidson, president, S. A. E.; sales manager, Diesel Engine Division, General Motors Corp.
A Trip Through the Machine Tool Show, by Joseph B. Geschelin, Detroit Editor, Automotive Industries.
Machine Tools in Modern Industry, by F. E. Crawford, president, Thompson Products Company; president, Cleveland Chamber of Commerce.

THURSDAY EVENING, OCTOBER 12

6:30 p. m.—General Electric Institute dinner meeting and lighting demonstration, Nela Park.

Railway Fuel and Traveling Engineers' Association

Hotel Sherman, Chicago

Tuesday, October 17

Morning Session

10:00 o'clock

Address by L. W. Baldwin, chief executive officer, Missouri Pacific Lines, on Training and Coaching Supervision.
(Opening ceremonies will be attended by combined memberships of the Railway Fuel and Traveling Engineers' Association, the Locomotive Maintenance Officers' Association [formerly the International Railway General Foremen's Association], the Car Department Officers' Association, and the Master Boiler Makers' Association, under the chairmanship of F. P. Roesch, vice-president, Standard Stoker Company.)

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11:00 o'clock

Address by John R. Jackson, President.

Appointment of special committees.

What Can Each Member Do To Promote the Effectiveness of the Railway Fuel and Traveling Engineers' Association, by E. L. Woodward, western editor, ***Railway Mechanical Engineer***

Afternoon Session

2:00 o'clock

Air Brakes—Chairman, W. H. Davies, superintendent air brakes, Wabash.
Sub-committee on Freight Brakes—Chairman, W. E. Vergan, supervisor air brakes, Missouri-Kansas-Texas.

Sub-committee on Handling of the Engineer's Brake Valve on Passenger Trains—Chairman, J. A. Burke, supervisor air brakes, Atchison, Topeka & Santa Fe.

Stationary Boiler Plants—Various fuel-burning appliances as they affect fuel economy—Chairman, R. S. Twogood, fuel engineer, Southern Pacific.

Wednesday, October 18—Mechanical Day

Morning Session

9:30 o'clock

New Locomotive Economy Devices—Chairman, A. G. Hoppe, assistant mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific.

Address by Lee Robinson, superintendent equipment, Illinois Central.

Address—A Few More Avoidable Factors in Design Affecting Fuel and Locomotive Performance, by F. P. Roesch, vice-president, The Standard Stoker Co.

Grates—Chairman, M. F. Brown, fuel supervisor, Northern Pacific.

Steam Turbine and Steam Condensing Locomotives—Chairman, L. P. Michael, chief mechanical engineer, Chicago & North Western.

Afternoon Session

2:00 o'clock

Utilization of Locomotives—Chairman, A. A. Raymond, superintendent fuel and locomotive performance, New York Central.

Locomotive Firing Practice—Oil—Chairman, R. S. Twogood, fuel engineer, Southern Pacific.

Locomotive Firing Practice—Coal, especially dealing with honeycomb—Chairman, W. C. Shove, general road foreman engines, New York, New Haven & Hartford.

Thursday, October 19—Fuel Day

Morning Session

9:00 o'clock

Fuel Wastes and Losses, by J. G. Crawford, fuel engineer, Chicago, Burlington & Quincy.

Fuel Records and Statistics—Chairman, E. E. Ramey, fuel engineer, Baltimore & Ohio.

Address—Fuel Economy from the Viewpoint of the Divisional Superintendent, by W. A. Hurley, assistant general superintendent, New York, New Haven & Hartford.

Address by George J. Leahy, National Coal Association, and Republic Coal and Coke Company.

Coal—Preparation washed and dried coals; inspection, utilization—Chairman, S. A. Dickson, supervisor fuel, Alton.

Routine business and election of officers.

Master Boiler Makers' Association

Hotel Sherman, Chicago

Tuesday, October 17

Morning Session

8:30 o'clock Registration*

10:00 o'clock Address by L. W. Baldwin, chief executive officer, Missouri Pacific Lines, on Training and Coaching Supervision.

(Opening ceremonies will be attended by combined memberships of the Master Boiler Makers' Association, the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association, and the Locomotive Maintenance Officers' Association [formerly the International Railway General Foremen's Association], under chairmanship of F. P. Roesch, vice-president, Standard Stoker Company.)

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11:00 o'clock Meeting called to order.

Address by President William N. Moore.

11:30 o'clock **Topic No. 9.** Report on Topics for 1940—Chairman, Myron C. France, general boiler foreman, Chicago, St. Paul, Minneapolis & Omaha.

Business.

Afternoon Session

1:30 o'clock Address by Roy V. Wright, editor, ***Railway Mechanical Engineer.***

Topic No. 4. (Continued from 1938—committee report and individual papers)—Problems created by chemical treatment of locomotive feedwater—Chairman, C. W. Buffington, general master boiler maker, Chesapeake & Ohio.

The Causes and Prevention of Embrittlement in Locomotive Boilers—A lecture with motion pictures, by Dr. W. C. Schroeder, senior chemical engineer, United States Department of Interior, Bureau of Mines.

Report of Special Committee appointed at 1938 meeting.

Routine business.

Wednesday, October 18

Morning Session

9:30 o'clock Routine business.

9:40 o'clock Address by D. S. Ellis, chief mechanical officer, Chesapeake & Ohio.

10:10 o'clock **Topic No. 1.** Training apprentices to be better mechanics—Chairman, A. T. Hunter, assistant general boiler inspector, Atchison, Topeka & Santa Fe.

Apprenticeship—A paper by M. M. Hanson, principal field representative Industrial Commission, Madison, Wis.

Report of the Executive Committee—Chairman, Carl A. Harper, general boiler inspector, Cleveland, Cincinnati, Chicago & St. Louis.

Report of Secretary-Treasurer Albert F. Stiglmeier.

Routine business.

Afternoon Session

1:30 o'clock Address by F. K. Mitchell, assistant superintendent of equipment, Cleveland, Cincinnati, Chicago & St. Louis.

2:00 o'clock **Topic No. 3.** (Continued from 1938)—Improving circulation in the locomotive boiler—Chairman, Carl A. Harper, general boiler inspector, C. C. C. & St. L.

Motion pictures of circulation of water in boiler.

4:30 o'clock **Topic No. 5.** Marking water level and highest point of crown sheet on the boiler head—Chairman, E. H. Gilley, general boiler foreman, Grand Trunk.

Routine business.

Thursday, October 19

Morning Session

9:30 o'clock Routine business.

9:40 o'clock Address by J. M. Hall, chief Bureau of Locomotive Inspection, Interstate Commerce Commission.

10:10 o'clock **Topic No. 2.** Welded alloy-steel tender tanks—Chairman, Leonard C. Ruber, superintendent boiler department, Baldwin Locomotive Works.

Morning Session

11:00 o'clock **Topic No. 6.** Longitudinal cracking of flues in service—Chairman, E. E. Owens, general boiler inspector, Union Pacific.

Afternoon Session

1:30 o'clock Routine business.

1:40 o'clock **Topic No. 7.** Standardizing the inspection, testing and cleaning of locomotive air reservoirs—Chairman, L. R. Haase, district boiler inspector, Baltimore & Ohio.

2:40 o'clock **Topic No. 8.** Renewing fireboxes—Laying out, fabrication, and application—Chairman, F. A. Longo, welding and boiler supervisor, Southern Pacific.

Election of officers.

Closing business.

Adjournment.

*Beginning Monday, October 16, 4:30 p. m. to 6:00 p. m., and each day following starting at 8:30 a. m.

Car Department Officers' Association

Hotel Sherman, Chicago

Tuesday, October 17

Morning Session

9:00 o'clock	Registration.
10:00 o'clock	Address by L. W. Baldwin, chief executive officer, Missouri Pacific Lines, on Training and Coaching Supervision. (Opening ceremonies will be attended by combined memberships of the Car Department Officers' Association, the Master Boiler Makers' Association, the Railway Fuel and Traveling Engineers' Association, and the Locomotive Maintenance Officers' Association [formerly the International Railway General Foremen's Association], under the chairmanship of F. P. Roesch, vice-president, Standard Stoker Company.)

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11:00 o'clock	Meeting called to order.
11:05 o'clock	Approval of minutes of last annual meeting.
11:15 o'clock	Address by President C. J. Nelson.

Afternoon Session

1:30 o'clock	Address by D. J. Sheehan, superintendent motive power, Chicago & Eastern Illinois.
2:30 o'clock	Report of Membership Committee—Chairman J. S. Acworth, supervisor of equipment, General American Transportation Corporation.
3:00 o'clock	Report of Secretary-Treasurer F. L. Kartheiser.
3:30 o'clock	Unfinished business.
3:45 o'clock	New business.
4:00 o'clock	Address by E. L. Woodward, western editor, ***Railway Mechanical Engineer*** and chairman of Publicity Committee.

Wednesday, October 18

Morning Session

9:00 o'clock	Freight and Passenger-Car Construction—Chairman, J. McMullen, superintendent car department, Erie.
10:00 o'clock	Address by C. H. Dietrich, executive vice-chairman, Freight Claim Division, Association of American Railroads.
10:30 o'clock	Shop Operation, Facilities and Tools—Chairman, J. A. Deppe, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific.
11:15 o'clock	Passenger-Train Car Terminal Handling—Chairman, G. R. Andersen, district master car builder, Chicago & North Western.

Afternoon Session

1:30 o'clock	Lubricants and Lubrication—Chairman, J. R. Brooks, supervisor Lubrication and supplies, Chesapeake & Ohio.
2:00 o'clock	Freight-Car Inspection and Preparation for Commodity Loading—Chairman, F. G. Moody, master car builder, Northern Pacific.
3:00 o'clock	Interchange—Chairman, M. E. Fitzgerald, master car builder, Chicago & Eastern Illinois.
4:00 o'clock	Loading Rules—Chairman, H. H. Golden, supervisor A. A. R. Interchange and Accounting, Louisville & Nashville.

Thursday, October 19

Morning Session

9:00 o'clock	Address by Leroy Kramer, vice-president, General American Transportation Corporation.
10:00 o'clock	Billing for Car Repairs—Chairman, D. E. Bell, A. A. R. instructor, Canadian National Railways.
11:00 o'clock	Painting—Chairman, L. B. Jenson, passenger shop superintendent, Chicago, Milwaukee, St. Paul & Pacific.

Afternoon Session

1:30 o'clock	Nominating Committee—Chairman, J. E. Keegan, chief car inspector, Pennsylvania.
	Election of officers.
	Suggestions for good of the association.
	Adjournment.

Locomotive Maintenance Officers' Association*

Hotel Sherman, Chicago

Tuesday, October 17

Morning Session

8:00 to 10:00 o'clock	Registration.
10:00 o'clock	Address by L. W. Baldwin, chief executive officer, Missouri Pacific Lines, on Training and Coaching Supervision. (Opening ceremonies will be attended by combined memberships of the Locomotive Maintenance Officers' Association, the Car Department Officers' Association, the Master Boiler Makers' Association, and the Railway Fuel and Traveling Engineers' Association, under the chairmanship of F. P. Roesch, vice-president, Standard Stoker Company.)

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Afternoon Session

2:00 o'clock	Report of President F. B. Downey outlining scope and purpose of Locomotive Maintenance Officers' Association.
	Report of Secretary-Treasurer F. T. James on past record of old association and status of new association.
2:30 o'clock	Proper Maintenance of Modern Locomotives—Address by D. S. Ellis, chief mechanical officer, Chesapeake & Ohio.
4:00 o'clock	Roundhouse Problems Caused by Long Runs, by F. J. Fahey, master mechanic, New York Central.

Wednesday, October 18

Morning Session

9:00 o'clock	Training of Apprentices—Address by A. H. Williams, general supervisor of apprentice training, Canadian National Railways.
10:30 o'clock	Forging and Heat Treating Locomotive Parts, by L. B. Herfurth, forging supervisor, Missouri Pacific.

Afternoon Session

2:00 o'clock	Failures of Locomotive Parts and How To Prevent Them—Address by F. H. Williams, assistant test engineer, Canadian National Railways.
3:30 o'clock	Scheduling of Locomotives Through Shops for Classified Repairs, by F. B. Downey, assistant shop superintendent, Chesapeake & Ohio.

Thursday, October 19

Morning Session

9:00 o'clock	What I Expect of My Supervisors and Why—Address by F. E. Lyford, trustee, New York, Ontario & Western.
10:30 o'clock	Best Methods of Selecting Machinery and Tools for Repairs to Modern Locomotives, by R. P. Dollard, shop engineer, Chesapeake & Ohio.

Afternoon Session

2:00 o'clock	Address by Lewis B. Rhodes, president, Allied Railway Supply Association.
3:30 o'clock	Election of officers.

*Formerly the International Railway General Foremen's Association.

EDITORIALS

The October Conventions

The final programs of the four conventions to be held at Chicago during the third week in October, which are printed in this issue, all promise meetings which will be well worth the attendance of those engaged in the respective branches of mechanical-department work. Not only is this suggested by the names of the speakers who will bring messages of challenge and inspiration to those fortunate enough to attend the meetings, but it is even more evident in the character of the working programs that deal with the problems which the various groups of supervisors have to meet in their every-day work throughout the year. Every one of these groups —the Master Boiler Makers' Association, the Car Department Officers' Association, the Railway Fuel and Traveling Engineers' Association, and the new Locomotive Maintenance Officers' Association—should be largely attended.

The new Locomotive Maintenance Officers' Association, which is evolving from the old International Railway General Foremen's Association, has an excellent program with which to start its new career. A good attendance at this year's meeting is especially desirable because it will provide the material from which to set up an effective working organization for the future.

With this in mind it is particularly deserving of support. The fact that particular attention has been called to it, however, does not imply that the other associations which are more firmly established should not be equally well supported. The work of each of these is well known, however. They have earned support and undoubtedly will receive it again.

France Takes The Lead

Those who read Lawford Fry's two-part review of André Chapelon's book, "La Locomotive a Vapeur," which appeared in the December, 1938, and January, 1939, issues of the *Railway Mechanical Engineer,* will look with particular interest for the article by the same author on another page of this issue, entitled "French Tests Show High Locomotive Efficiencies." In this article, which deals with the performance obtained from the locomotive rebuilt in accordance with the principles set forth by Mr. Chapelon, Mr. Fry has translated into English terms the dimensions and performance of the Paris-Orleans-Midi rebuilt 4-8-0 locomotive and has analyzed the results so that they may be compared with familiar American performance.

For many years American motive-power men have been inclined to think that in the matter of scientific development of the steam locomotive we led the world. In recent years, however, it is evident that for truly scientific developments of the steam locomotive France has stepped well out ahead of the rest of the world.

The rebuilt French locomotive with which Mr. Fry's article deals has a total engine weight of 240,000 lb. and develops a maximum indicated horsepower of approximately 3,700—an indicated horsepower for each 65 lb. of total engine weight. This locomotive has a combined evaporative and superheater heating surface of 3,022 sq. ft., thus developing an indicated horsepower for each 0.82 sq. ft. of heating surface. The New York Central J3 class 4-6-4 type locomotive is the best American design for which performance data are available. This locomotive has a total engine weight of 360,000 lb. It has developed a maximum of 4,700 i. hp.—one horsepower for about 77 lb. of engine weight. It has a combined evaporative and superheater heating surface of 5,932 sq. ft., thus developing a horsepower for each 1.26 sq. ft. of combined heating surface.

The outstanding performance of the French locomotive is not the result of any striking departures from the well-established basic features of steam locomotive anatomy; it is evidence of the importance of the careful study and proportioning of details, particularly those affecting the use of steam, some which have apparently never given the American designer serious concern.

The steam locomotive is being subjected by the Diesel-electric locomotive to the most serious challenge for its place on the railways which it has ever had to face in its entire history. Its strongest competitive advantage is its relatively low first cost which makes the question of a low weight-power ratio a particularly important one. Furthermore, the high thermal efficiency implied by the high horsepower output of the French locomotive is also becoming of increasing importance as the competition of motive-power types continues to develop. The same painstaking attention to detail improvements that is evident in the recent French developments is much needed at the present time in the development of the steam locomotive in America.

Modern Passenger Cars

Beginning in 1930 with the advent of air conditioning, a remarkable evolution has been taking place in the railway passenger car. Air conditioning, which, up to July 1, has been applied to over 11,000 railroad-owned and Pullman cars, according to reports received by the Association of American Railroads, is an old story. So

also are some of the other improvements which are now accepted as established features of the modern passenger coach. Setting them down so that one may see them all at once, however, leaves one definitely with the impression that the evolution of the passenger car which began nine years ago has accelerated rapidly into little less than a revolution during the last half of that period. This applies not alone to features affecting the comfort and attractiveness of the cars, but to the structure as well.

Ideas as to passenger-car construction and weight have been greatly changed by three new types of structural material and the new techniques of fabrication which are being employed with them. More and more evidence of the acceptance of the light-weight designs thus made possible is appearing every day. All this has taken place in the past five years.

The improvements and refinements affecting the attractiveness and comfort of railway passenger travel are many and varied. The replacement of the walk-over type seats, first with the automotive "bucket" type and then with the rotating-reclining type which permit shaping seats for comfort, is a major improvement in itself. It has been supplemented by the advent of sponge-rubber cushions which are sanitary and an aid in the making of comfortable seats.

One of the striking improvements in the modern passenger coach is in the toilet and lounge facilities, both of which, in appointments as well as in spaciousness, are comparable with those long enjoyed by the Pullman patron.

The new era of interior design and decoration, made possible by the cleanliness resulting from pressure ventilation, is wielding a tremendous influence in renewing the interest of the American public in railway travel. Few new passenger-carrying cars are turned out today in the interior design of which competent talent in the interior decorator's art is not consulted. Violations of good taste and the creation of depressing effects are thus being avoided.

Probably no feature of the passenger car affecting the comfort and pleasure of the traveler is receiving more intensive study than car lighting. This has three objectives: First, to affect an increase in lighting intensity and improvement in distribution neither of which has been up to the physiological requirements for the avoidance of eye strain; second, the attainment of higher efficiency in the production of the light and in its utilization, and, third, making the lighting an attractive and harmonious feature of the decorator's scheme for the interior treatment of the car. As fast as new types of lamps are brought out, they are being adapted for use in car lighting, and the new plastics are being utilized in numerous ways for the control of light distribution and for achieving striking and beautiful decorative lighting effects.

The sliding-sash type of coach window was long a source of annoyance to passengers because it so frequently could not be opened and, when closed, was the source of annoyance because of the infiltration of dirt and, in the winter time, of streams of unpleasantly cold air. Air conditioning has removed the necessity of opening windows, and, by dehydration, the modern double-sash window, which tightly seals the opening into the car, can be kept free of steam and frost. Clear plate glass also improves the pleasure of railway travel.

Definite improvements are being made in the riding comfort of passenger cars. This applies to truck suspensions and draft gears in the design of both of which the importance of low rates of acceleration in the movements which they are designed to control is beginning to receive recognition. In this connection, sound insulation should also be mentioned. The reduction in the transmission of high frequently vibrations, both within and without the sound range, adds greatly to travel comfort and reduces a source of nervous irritation.

Reductions of weight amounting to one-third or more constitute a strong economic factor in favor of the gradual retirement of old passenger equipment and its replacement with new cars of completely modern construction. The amount of the investment involved, however, calls for a program covering an extended period. With the possible exception of the improvement in trucks, all of the changes affecting the comfort and attractiveness of passenger travel can be installed in existing cars. It is unnecessary, therefore, to limit the rate at which the benefits of improved passenger appeal can be made effective to the rate at which the old cars can be replaced with new ones, completely modern.

Most roads are wisely giving consideration to such modernization of existing passenger cars. These programs of rehabilitation start with the cars for the best trains and gradually include equipment for all main-line service. When they have been completed, however, an end will not yet have been reached. Cars for local service, and even those for commuter travel, should then be added to the program. Only in this way can the railroads take full advantage of the possibilities of the features of the modern passenger car for building up favorable public interest. Indeed, to stop short of a complete job will tend to create a positively unfavorable reaction, the ultimate effect of which will reach far beyond the local service in which it arises.

Are Good Mechanics Needed Any More?

Along about 1930, when things in industry really began to go bad in a big way, there came forth numerous individuals and groups who offered all kinds of explanations as to why things were going wrong and were just as prolific in their offerings of solutions to effect quick changes and restore prosperity. The fact that most of the explanations failed to explain and most of the solutions turned out to be just crazy ideas does not alter the fact that in 1930 were born many of the ideas that have since proved responsible for the position that American industry is in today. It is only human nature for some people to dissipate most of their energies in looking for someone on whom to blame things rather than to search

for an intelligent, long-time solution to their problem.

What we are leading up to is a consideration of the statement that has been dinned into our ears for almost 10 years to the effect that the development of the modern machine has proceeded at such a rapid pace that the men who have been displaced by the enormous increases in the productive capacity of machine tools cannot be absorbed by industry for other kind of work. Add to this, then, the belief of many, under such conditions, that industry has bent all its efforts to the development of the machine and has paid little or no attention to the development of the man who runs it. Stated in other words these people believe that since the brains and skill have been built into the machine any mediocre operator can get all that is necessary out of it. The fallacy of this belief is evident on every hand today and there is not an industry, from the builder of the tools to the ultimate user, that is not seriously handicapped by the lack of thoroughly trained mechanics and machine operators.

In the railroad industry few men have been hired within the past 10 years to reinforce the ranks of skilled workmen. Our apprentice training systems were practically abandoned at the beginning of the depression, thereby effectively stopping the inflow of new blood into the mechanical departments of our railroads. The necessary reduction of forces due to the curtailment of operations took its toll not only of the workmen who entered service 20 years ago but started to cut seriously into the ranks of the still older men who were approaching retirement age. So, today the industry stands at the threshold of a period in which skilled mechanical workmen are quite surely to be in the greatest demand and is in the vulnerable position of having its supply of such talent at the lowest point in years.

This is a machine age and the productive capacity of the modern machine tool has been greatly increased due to the strides that have been made in the development of new materials out of which to build a more rugged machine; in the development of modern tool steels that will stand up under the gruelling punishment of feeds and speeds that were undreamed of a few years ago; in the ingenious designs that have been worked out for tooling arrangements that permit moving from operation to operation with intervals of seconds where minutes formerly were necessary and, finally, the designers of electrical and hydraulic controls and mechanisms have tied all of these improvements together in such a manner that a single operator can command their many functions with the greatest of ease. These are the things that have made it possible for a single workman to remove more metal or finish more parts in an eight-hour day today than could have been done in a week a few years ago.

Regardless of the fact that the railroads do not buy nearly as many locomotives and cars as they formerly did no one will deny that remarkable progress has been made in the development of the locomotive. In fact, when one considers the transportation capacity of the modern steam and Diesel locomotive the railroad industry may take a certain amount of pride in the fact that it has kept pace with other industries in this respect. It is also a fact that as far as the engineman is concerned it is necessary for him to possess a much broader mechanical knowledge to hold down his job today than was demanded of his predecessor of 20 years ago. Such a parallel may be found in the shop and the only reason that its importance has not been greatly emphasized is that the installation of modern shop tools and equipment has not kept pace with the installation of modern motive power.

The railroads must have modern tools in order to cut the cost of production as well as to provide reserve production capacity in the face of a diminishing supply of skilled labor. They must also very soon begin to give serious thought to the problem of bringing in and training the kind of men who will have the mechanical knowledge necessary to get out of the modern machine tool the productive capacity that the tool builder put into it. One glance at some of the new tools that will take their place in the industrial production line next year should convince anyone that not only are good mechanics still needed but that they are going to have to be of a different type than mechanics of 20 years ago.

What are the railroads going to do—stand by until the emergency is upon them and it is too late to fill the gaps, or, plan an intelligent program of building shop organizations with the men that will be needed five and ten years from now?

New Books

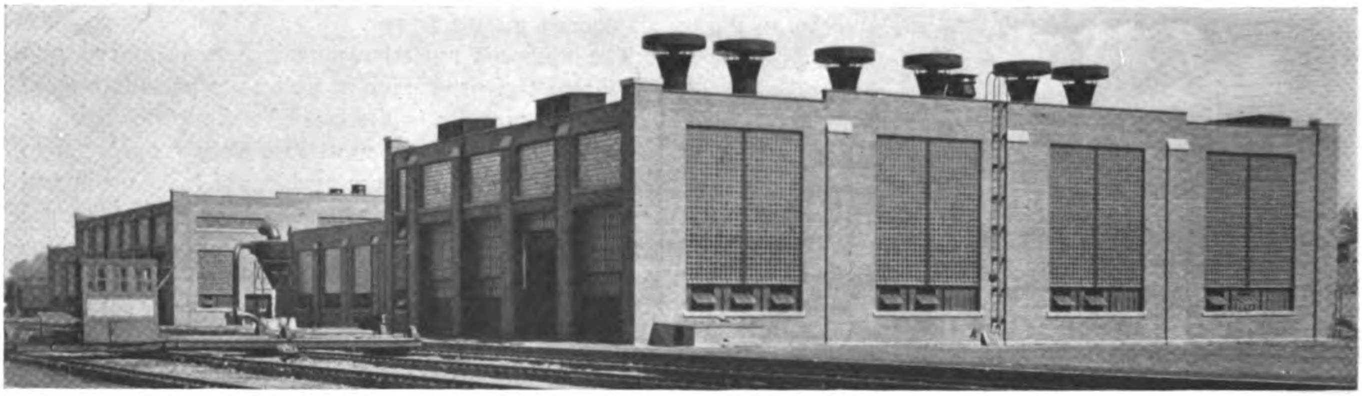
THE LOCOMOTIVE RUNNING DEPARTMENT. *By John G. B. Sams. Published by The Locomotive Publishing Co., Ltd., 3 Amen Corner, E. C. 4, London, England. 104 pages, illustrated. Price, $1.*

The seven chapters of this book on English practice cover engine-terminals; mechanical and other appliances used about the terminal; locomotive operation; storekeeping; locomotive failures and routine inspections; train operation; road failures, and train operation. The book has been written especially for students and others interested in locomotive operation.

LUBRICANTS AND LUBRICATION. *By James I. Clower, B.S., M.E., associate professor of machine design at the Virginia Polytechnic Institute. Published by the McGraw-Hill Book Company, Inc., New York. 464 pages, illustrated. Price, $5.*

The first eleven chapters of this book are devoted to the fundamentals of lubricants and lubrication. The author discusses fully the source, production, and refining of lubricants, and the theory of lubrication. The next six chapters cover in detail the lubrication of steam turbines, steam engines, air compressors, refrigerating machines, and all types of internal combustion engines. The general principles and practices as set forth in the first eleven chapters are applied to specific machines. The last chapter points out the principles and proper practices for the storing and handling of lubricants.

With the Car Foremen and Inspectors



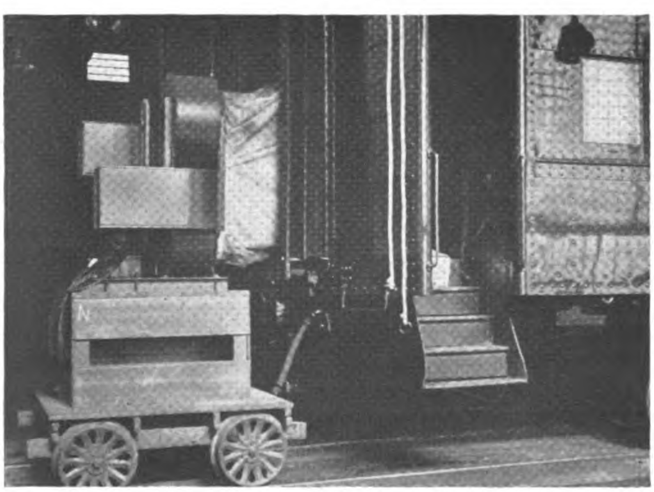
New C. & E. I. coach shop has glass-block walls and Binks paint-spray exhaust equipment

C. & E. I. Builds

New Danville Coach Shop

Steel, brick and glass-block structure is provided with modern equipment throughout for maintaining system passenger-train equipment

THE Chicago & Eastern Illinois now has in operation at Danville, Ill., a thoroughly modern coach shop, recently completed at a cost of $250,000, and built to replace the old shop which was destroyed by fire on November 22, 1937. The extensive use of glass-block construction in the side walls and the provision of complete spray-painting facilities throughout are features of the new shop. The C. & E. I. equipment which will be overhauled and rebuilt at this shop includes 48 head-end cars, such as baggage, mail and express and combination cars, 38 passenger cars and 7 dining cars, all of which are of steel construction and air conditioned with the exception of three which will be equipped for air-conditioning during 1939 at the Danville coach shop.



Portable truck-mounted fan and hood used in exhausting air from car interiors

In order to maintain these cars properly, they are shopped on a definite schedule. Dining cars are taken into the shop every 18 months for complete overhauling, repainting and reconditioning. Passenger-carrying cars are shopped every 24 months for complete overhauling and head-end cars every 36 months. The shop is organized and designed for an output of 2½ to 3 cars a month, with a force of 47 men, including 4 supervisors, 16 coach car men, 2 cabinet makers, 1 truck man and helper, 5 painters, 2 upholsterers, 2 electricians, 6 sheet metal workers and 2 helpers, 2 electrician helpers, 1 electric welder and 3 laborers. This force also takes care of a large amount of shop-order work which is quite extensive, especially in the upholstery shop and sheet metal shop, such as the manufacture of locomotive cab curtains and cushions, repairs to office furniture, awnings, arm rests, etc. The man-hours of work on shop orders sometimes exceeds that on car repairs.

Description of the New Shop

As shown in the drawing, the shop building extends in an east-west direction, being adjacent to a transfer table and occupying an area practically 110 ft. wide by 417

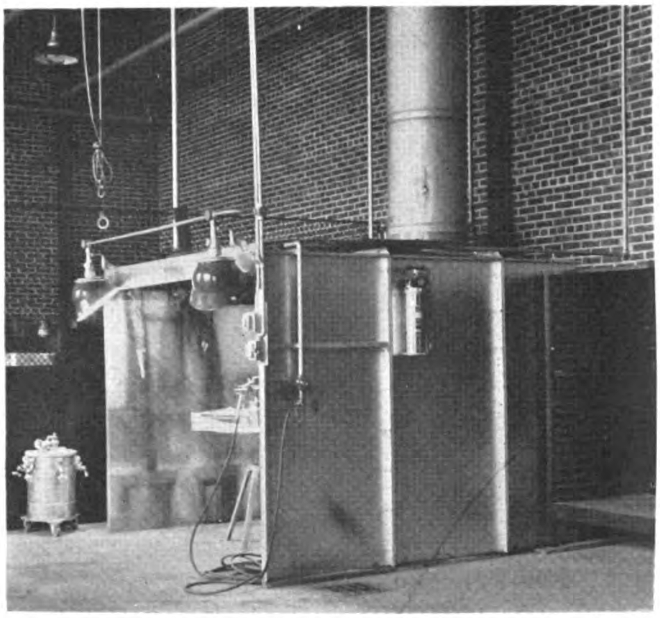
ft. long. The west wing, 90 ft. 10 in. long, is the paint shop, equipped with Tracks 1 to 4, spaced on 19-ft. centers. Next is a 150-ft. section, only 82 ft. wide, devoted to the varnish room, upholstering, pattern and cabinet shops. The coach shop occupies the full width of the building for a length of 126 ft. and includes Tracks 5 to 10 inclusive. The east end of the shop, for a length of 49 ft. 7 in., houses the pipe shop, battery room, tool crib, washroom and toilet.

Referring to the elevation drawing, it will be seen that the paint and coach shops occupy the full height of the building, namely, 30 ft., whereas the other departments, needing less head room, are only 20 ft. high. This contributes to economy in the construction and heating of the building and facilitates getting additional light into the paint and coach shops without going to the familiar saw-tooth type of roof.

The building is constructed of steel and brick with a large proportion of the wall area composed of individual hollow glass blocks about 8 in. square by 4 in. thick, set in cement and arranged in large window groups. These glass blocks are not transparent but admit a high percentage of visible light rays, have a certain insulating value and are largely self-cleaning on the exterior through the action of rain water. The shop is heated with steam by means of unit fan-type heaters, located as required and supplied by the American Blower Company. General illumination for operation of the shops on dark days and at night, when necessary, is supplied by drop-light fixtures with reflectors. The large shop door at each of the ten tracks is a two-part steel and glass door which operates vertically and can be quickly and easily opened or closed by means of an endless chain and pulley arrangement.

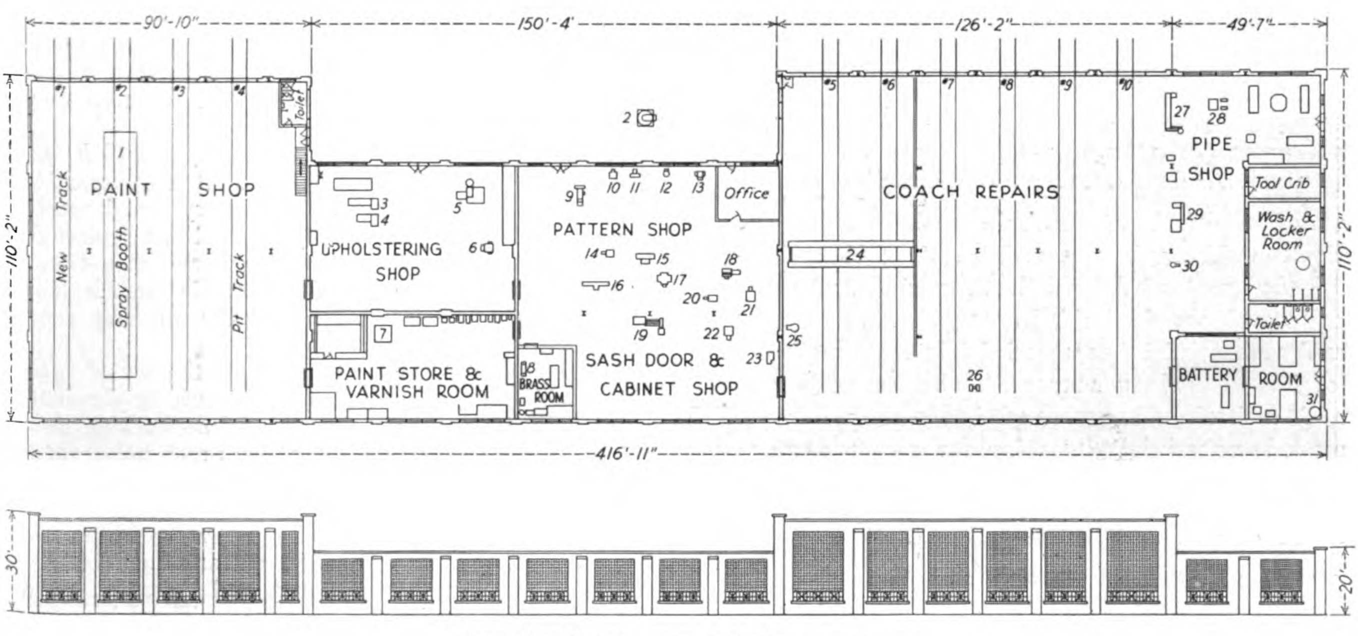
An important feature of this shop is the location of all departments on the ground level which saves both time and labor otherwise required in moving materials to and from the cars. The main shop office is located in one corner of the pattern and cabinet shop at approximately the center of the shop building. A Kirk & Blum shaving exhaust system is installed, with pipe connections to individual woodworking machines and a centrifugal shaving collector nearly opposite the main office door.

The paint shop is equipped with a pit on Track 4 to facilitate inspection and stripping operations and over

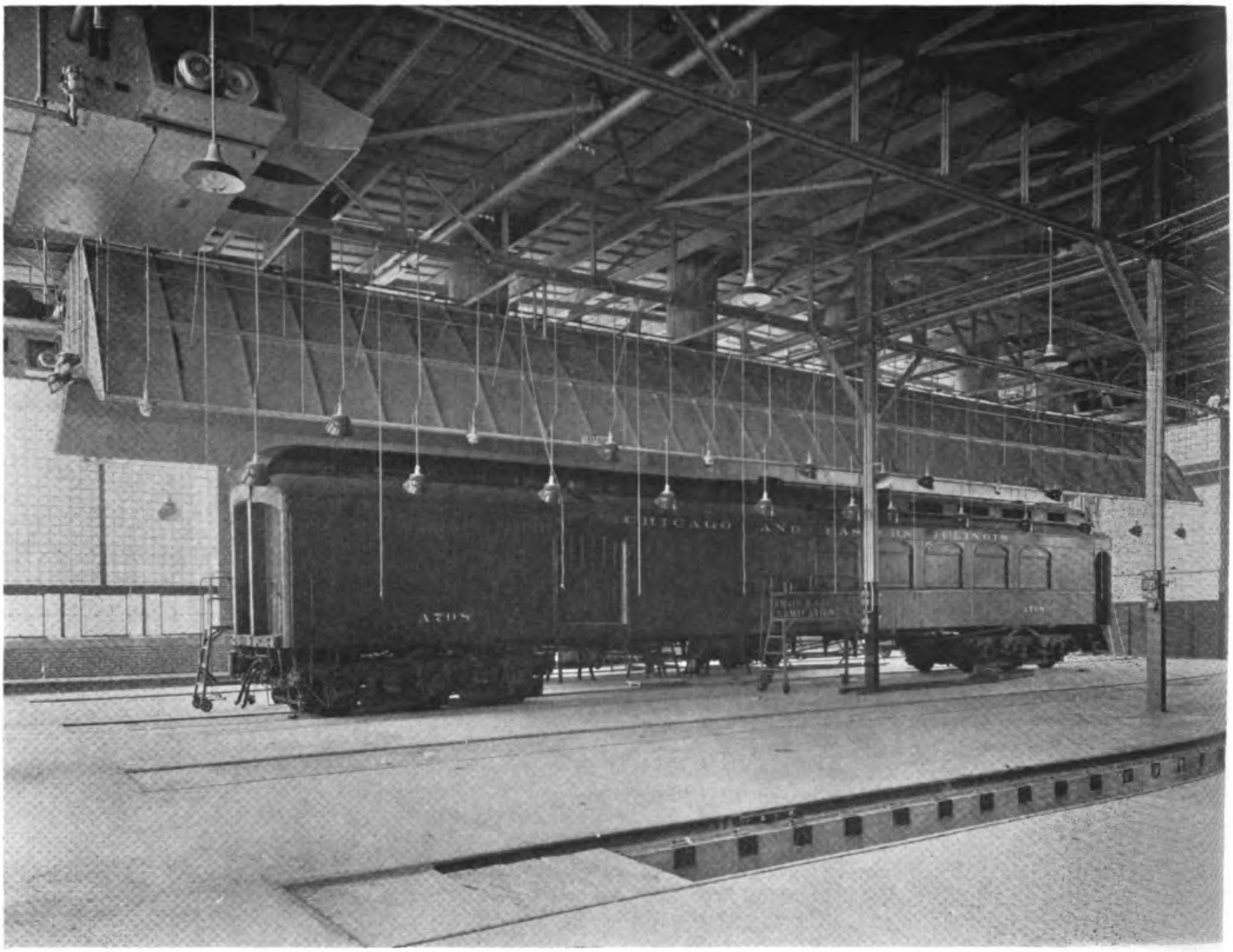


Binks spray hood and equipment used in painting car sash, trim and all small parts

Track 2 there is a Binks paint spray exhaust canopy, 90 ft. long, 16 ft. 6 in. wide by 7 ft. 8 in. high, made of No. 20 gage steel, painted with aluminum and divided into six sections to permit single or multiple operation. This canopy is supported by ten 4-ft., 5.4-lb., channels 18 ft. long, spaced on 10 ft. centers, bolted to the bottom chord of the roof trusses and reinforced by sway bracing. The unit consists of one inner canopy and one outer canopy properly suspended to give the correct areas for air distribution and connected to six 42-in. dia. galvanized-iron stacks 12 ft. long with automatic dampers, two clean-out doors and a 42-in. exhaust fan for each stack. The unit has two concrete floor ducts 18 in. by 18 in. by 98 ft. 8 in. long, equipped with one blower having a capacity of 18,300 cu. ft. per min., driven by a 10-hp. explosion-proof, 44-volt, 60-cycle, 3-phase motor. The canopy is lighted by fifty-four 200-watt lamps with 12-in. explosion-proof reflectors.

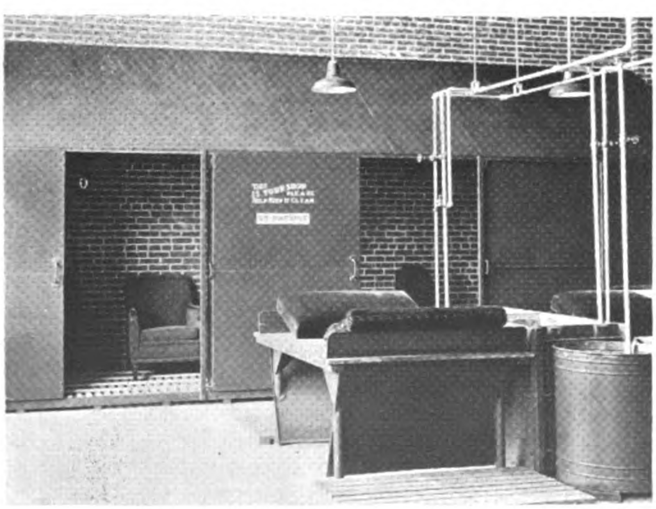


Floor plan of the new C. & E. I. coach shop



Binks 90-ft. exhaust canopy on Track 2 in the paint shop—Track 4 is the stripping pit

The upholstery shop, immediately adjacent to the paint shop, is 46 ft. by 66 ft. and equipped with two Singer sewing machines, cushion washing and dyeing facilities, and an Atlas 24-in. hair picker. Also located next to the paint shop and separated from it only by a fire wall, is the paint stores and varnish room for spraying smaller pieces, such as sash, seats, furniture and other car trim. This room is 33 ft. by 66 ft. and houses, besides the paint store room in one corner, a small Binks paint-spray cabinet which is used to draw fumes out of the shop while spray painting all small materials. The varnish room is well equipped with sash racks, lift trucks, etc. The pattern and cabinet shop, 80 ft. by 84 ft., includes the shop office in one corner, as stated, and the rest of the space is devoted to the convenient location of 15 woodworking machines of various types and kinds, as shown in the table, which are needed for doing the different classes of work required in this department.



Cushion washing, dyeing and drying facilities

In the coach shop, about 126 ft. long by 110 ft. wide, Track 5 is devoted to truck repairs. It is equipped with a 15-ton traveling crane and necessary small machine tools. Track 6 is used for the removal and replacement of trucks, the cars being jacked one end at a time by means of two Whiting 25-ton portable electric hoists. Tracks 7 to 10 inclusive, are used for car body repairs and rebuilding.

One innovation in the coach shop is the use of adjustable double scaffolds which may not only be elevated to any height desired for the most efficient working on car sides and roofs, but are designed with retractable vertical 5-in. I-beam supports which may be disconnected at the bottom and drawn up out of the way when not in use. The platforms are counterbalanced with scrap superheater-flue sections filled with lead and may be easily pushed up or down by one man and locked at the desired elevation in the usual manner. The I-beam supports, also counterbalanced in the same manner, are de-

signed so that they may be easily raised or lowered. They are guided in the upper channels, which are hung from the roof trusses. With the I-beams locked in the upper position, the coach shop presents a much neater and less congested appearance and, what is even more important, it is easier to work around the cars, especially when applying large material such as side sheets, battery boxes and air-conditioning units.

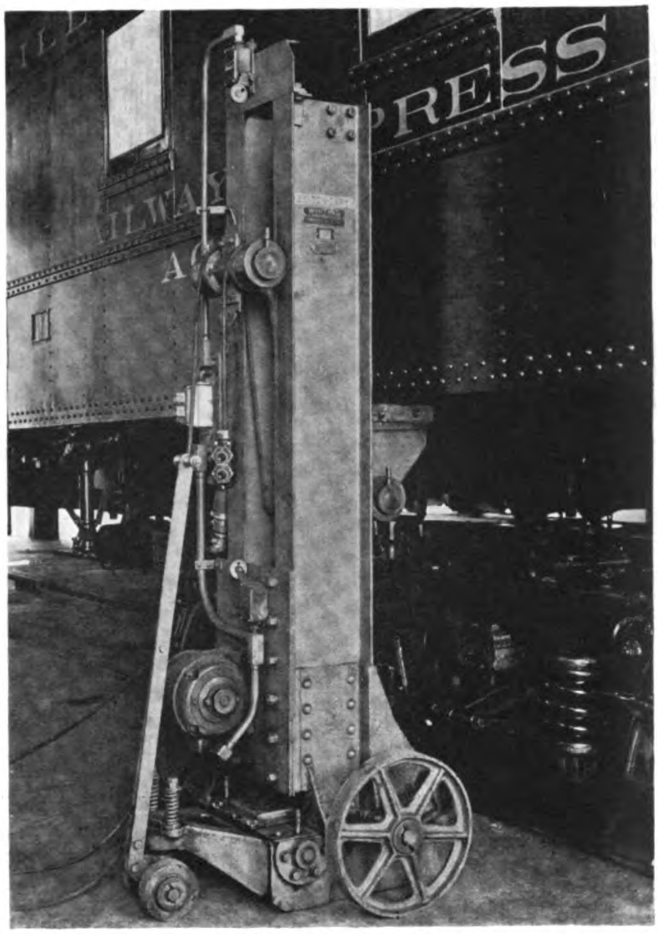
The relatively large and well-equipped pipe and sheet-metal shop is located conveniently with respect to car maintenance operations and special tools include a 10-ft. bending brake, 36-in. squaring shears, a metal-cutting band saw and a high-speed drill. The 25-ft. by 47-ft. battery room is designed for the efficient rebuilding and charging of batteries, a mono-rail hoist being used in handling the batteries. A 50-gal. still supplies distilled water.

A spacious wash and locker room is located in the east end of the building. This is equipped with large individual lockers, 10-man circular washbasins and three shower baths.

Method of Operation

Passenger cars, received for general repairs at the Danville shops are stripped on Track 4, in the paint shop, the cushions, seats, backs, curtains, chairs, etc., including rugs and paddings, going to the upholstery shop where they are cleaned, renovated and repaired or made new, as required. Sash, doors, diner equipment, sash stops, tables, etc., are removed and placed in the varnish room where they are washed and taken to the sash and cabinet shop for inspection, repair or renewal, as needed. These parts are then returned to the varnish room for refinishing under the small Binks spray hood.

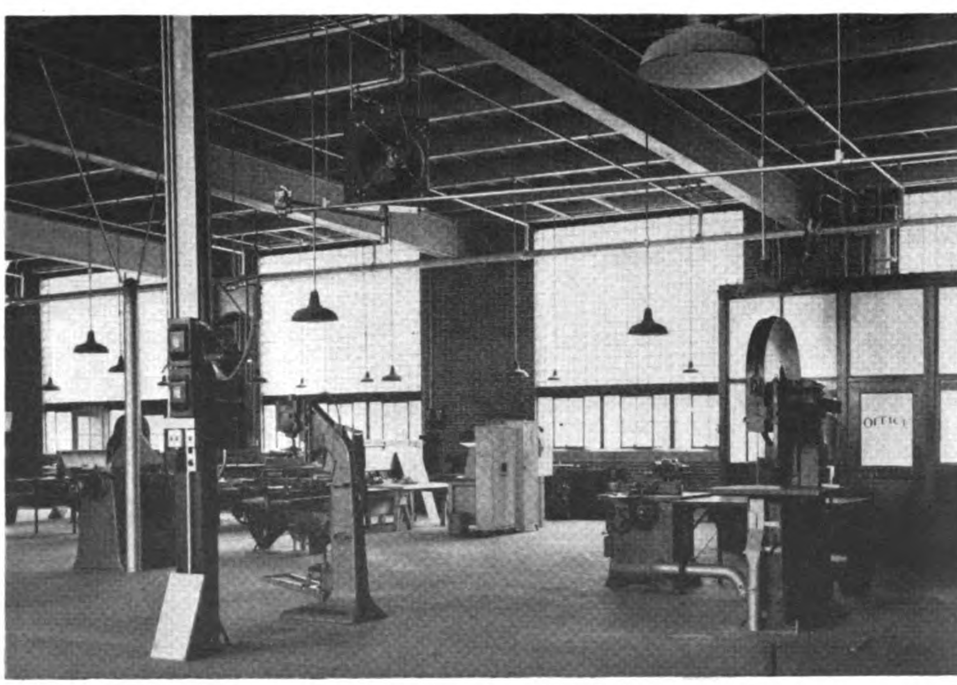
After stripping on Track 4, the car is moved, via the transfer table, to either Tracks 1 or 3, where it is washed and cleaned. It is then being removed to Track 6 in the coach shop where the car is jacked up and the trucks transferred by crane to Track 5 for repairs. The car, mounted on dolly trucks, is then moved to either Track 7, 8, 9, or 10 for all necessary repairs to the body, underframe, roof, vestibule, brakes, air-conditioning equipment and all underneath parts. When repaired, the car is then moved back to Track 6, re-trucked and moved over the transfer table to Track 2 under the Binks spray canopy.



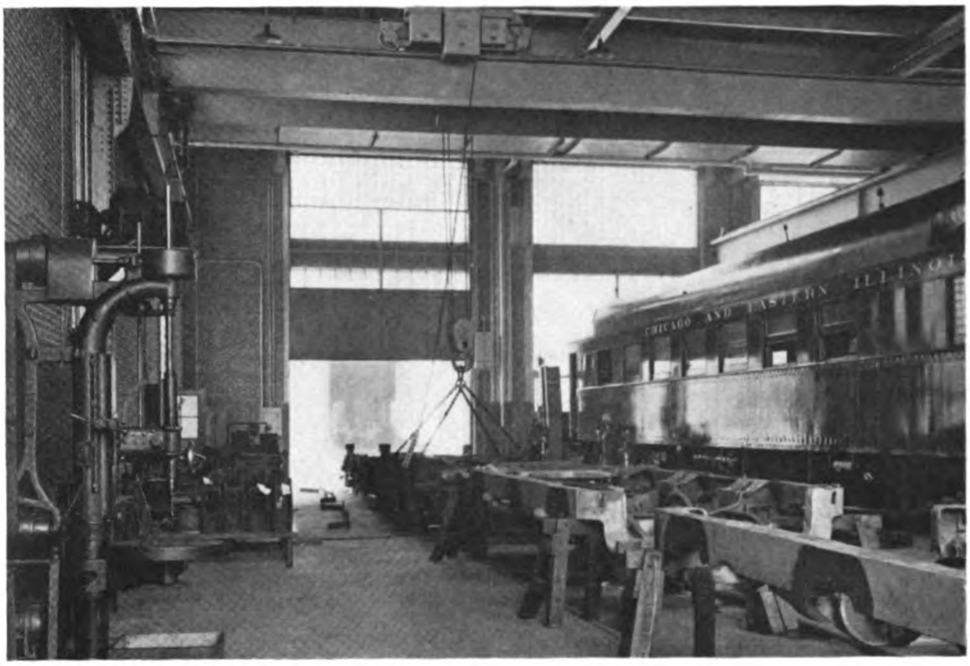
One of the Whiting 25-ton portable hoists used in jacking cars

Here all necessary painting is done quickly, efficiently and safely, as regards both personal health and fire hazards.

In connection with painting, one of the illustrations shows an air exhausting device which is applied to car ends whenever the interiors must be sprayed without removing the sash. Two blower fans, driven from a $1\frac{1}{2}$-hp. electric motor, are mounted in a sheet-metal housing



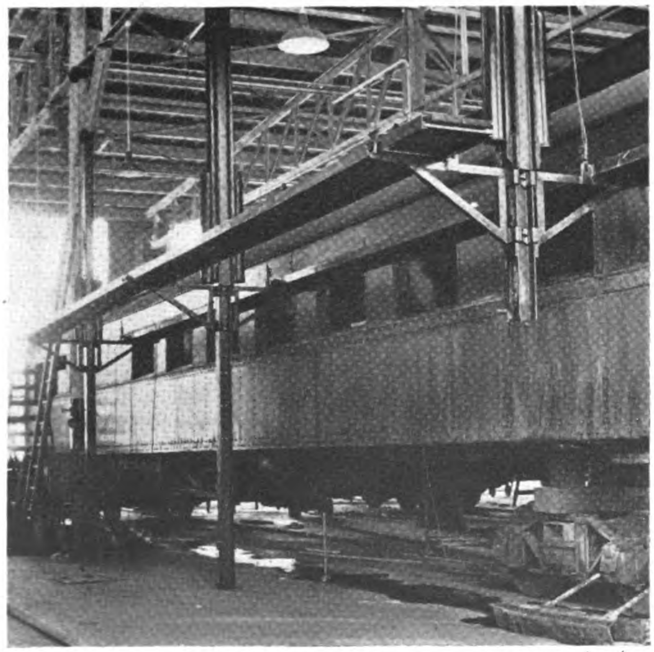
The pattern shop



Tracks 5 and 6 in the coach shop where trucks are removed and repaired

with canvas bellows connection to a steel frame which may be readily fastened to the end-door opening, the bellows extending across the vestibule. With the door in the opposite end of the car open and these blower fans operating, a sufficient circulation of air is secured in the car interior to make the working conditions satisfactory. Fume-laden air is exhausted upward from the blowers and passes out through the roof of the Binks exhaust canopy. The blower fans, housing, etc., of this device are mounted on a hand truck for easy portability about the shop.

At the completion of painting operations on Track 2, the car goes back to Track 4 for trimming and the installation of auxiliary equipment not previously applied. All air-conditioning apparatus, steam and water equipment, and air brakes are tested and adjusted and the car is then ready to move to the shipping track and be placed in service.



Adjustable double scaffold designed with vertical I-beams which telescope the upper supporting channels

C. & E. I. Passenger-Car Repair Classification

In the classification of passenger-car repairs, the condition of the exterior finish is a basic consideration. On the C. & E. I., Class I repairs consist of complete removal of the exterior finish by sandblasting and refinishing, at a cost of $3,000 to $5,500. Class 2 repairs consist of washing the exterior finish and maintaining the lettering, but otherwise performing a full general repair at almost as much expense as the Class I job. Class 3 repairs consist of refinishing the exterior without removing the old paint or stripping the car, at a cost of $300 to $600. Class 4 repairs constitute any work which holds the car out of service two or three trips at a cost of $100 to $200.

In the case of Class I repairs at Danville shops, the car is sent from Track 4 to the sandblast position east of the shop, where the finish is removed. The work of repainting and refinishing cars requiring Class 2, 3, or 4

Equipment Installed at the New C. & E. I. Coach Shop, Danville, Ill.

1—Binks 90-ft. paint-spray exhaust canopy
2—Kirk & Blum shaving-exhaust system
3—Singer sewing machine for light work
4—Singer No. 7-34 sewing machine for rugs, carpets, etc.
5—Cushion-washing and dying facilities
6—Atlas 24-in. hair picker
7—Binks spray booth (small)
8—U. S. Electric 2-head 4-speed Model 95 burnisher
9—Oliver 20-C wood lathe
10—Driver drill press
11—Yates American J-47 15-in. disc sander
12—Yates American J-45 20-in. oscillating spindle sander
13—Oliver No. 585 variety oilstone tool grinder
14—Yates American Y-20 20-in. bandsaw
15—Yates American No. 1 20-in. hand jointer
16—Yates American G-44 swing cut-off saw
17—Yates American B-44 24-in. planer
18—Yates American G-87 tilting-arbor rip saw
19—Yates American C4-A moulder
20—Yates American U-21 vertical-motor boring machine
21—Fay & Egan No. 50 band saw
22—Fay & Egan No. 379 vertical mortiser
23—Fay & Egan No. 70 tenoner
24—Harnischfeger 15-ton travel-lift crane, floor controlled
25—Hillis-Clark 24-in. upright drill press
26—U. S. electric double tool grinder
27—Chicago 10-ft. bending brake
28—Pexto 36-in. squaring shears
29—Atlantic 36-in. band saw equipped with metal-cutting blade
30—Manning, Maxwell & Moore speed drill
31—Polarstill still, 50 gal. per hour capacity

repairs is all done in the new shop without any outside movement except over the transfer table.

No shop schedule covering detail car parts is used at the new Danville coach shop, owing to the relatively small number of cars which must be handled. The cars are scheduled in the shop, thoroughly inspected, necessary material ordered and the out-of-shop dates set, the various shop department foremen watching this general schedule and completing their work so as to get the cars out on time. The principal advantage of this new coach shop is that it permits turning out a better grade of passenger-car maintenance work at lower unit cost. This is made possible largely by provision of the right kind of tools at the right place and the location of the various shop departments so as to save both time and labor in handling materials. No inconsiderable factor is the improved morale of the men who have not only a safe and comfortable shop in which to work, but benefit from unexcelled locker and washroom facilities, as well as machines and equipment which eliminate most of the heavy manual labor in passenger-car repair operations.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Insufficient Information of Car Damage Subject to Rule 44

On July 30, 1937, Atlanta, Birmingham & Coast flat car No. 9112 was damaged on the Wheeling & Lake Erie at Brewster, Ohio. The W. & L. E. submitted to the A. B. & C. joint inspection and a report of how the damage occurred and asked for disposition of the car under A. A. R. Rule 120. The A. B. & C. declined to make an inspection of the car and would not agree that the owners were responsible. The W. & L. E. stated that the car was damaged in the following manner: The A. B. & C. flat car was standing on track No. 4 behind one car and ahead of eight cars. The conductor, in making up a train, took 19 cars from track No. 5 and coupled them to those on track No. 4 and while pushing this draft of cars toward the rear of the track the A. B. & C. car buckled in the center. No other cars in this draft were damaged, and the W. & L. E. contended that the damage did not occur under any of the provisions of Rule 32. The A. B. & C. contended that the damage was caused by impact switching and came under the provisions of Rule 32. At different dates the W. & L. E. furnished the A. B. & C. with statements of the conductor, the general yardmaster, and the assistant trainmaster who were concerned with the damaged car. These statements differed as to the circumstances under which the damage occurred.

In a decision rendered November 17, 1938, the Arbitration Committee stated: "The evidence furnished by the Wheeling & Lake Erie as to the circumstances under which the damage occurred is conflicting and, therefore, the responsibility of the car owner has not been established under the provisions of Rule 44. The contention of the Atlanta, Birmingham & Coast is sustained."—*Case No. 1765, Wheeling & Lake Erie versus Atlanta, Birmingham & Coast.*

Bill for Repairs Claimed Excessive and Unwarranted

On February 10, 1938, the Southern made repairs to a St. Louis-San Francisco stock car at its Columbia, S. C., shop and rendered bill for $129.34 against the owner. After the repairs were completed the car was moved empty by the Southern to Birmingham, Ala., and delivered to the owner. The S. L.-S. F. took exception to the charge and contended that the repairs were made in violation of A. A. R. Rule 1 and as there was no question involving the safety of the trainmen or lading and the Southern had a direct connection with the home line the car could have been moved to Birmingham with safety and without repairs. The Southern contended that Rule 1 (b) did not contemplate the movement of a car for several hundred miles to effect delivery, and that the delivery of the car home empty had no bearing on the case as neither the mechanical nor the yard forces at Columbia had any assurance that the car would not be loaded after leaving Columbia.

In a decision rendered November 17, 1938, the Arbitration Committee stated: "The Southern Railway having a direct connection with the car owner, the repairs made were in violation of Rule 1 (b) and the bill should be cancelled."—*Case No. 1767, St. Louis-San Francisco versus Southern.*

Repairs of Defects on Car Moving Home for Repairs

The Southern shopped Keith Railway Equipment Company's tank car No. 8116 at Meridian, Miss., on September 8, 1936, for renewal of decayed running boards, and for running-board bolts, sill-step bolts, grab-iron bolts and similar items which were worn and loose, and also for the cleaning of air brakes and the periodical repacking of the journal boxes. The Keith Railway Equipment Company took exception to the charges for these repairs, claiming that the car was being moved to their shops for repairs. This car was received from the Mobile & Ohio for delivery to the Yazoo & Mississippi Valley, for whom the Southern acts as agent and makes repairs to all equipment at Meridian. The Southern contended that when the car was received from the M. & O. it carried no card or other marking indicating that the car was en route home for repairs, and furthermore, the condition of the running boards and the various bolts was such as to be dangerous and a hazard for trainmen and due to the nature of the defects they could not have been temporarily repaired, but required entire removal. The Keith Railway Equipment Company contended that the Southern was not furnished any orders on the above car because the car was not billed over their line, and that the lines over which the car was ordered to move had respected the owner's wishes to make their own repairs as requested by the notation on the way-bill, "Home shop for repairs."

In a decision rendered November 17, 1938, the Arbitration Committee stated: "As agent for the Yazoo & Mississippi Valley the Southern was justified in repairing the defective safety appliances and other defects it considered necessary for the safe movement of the car. The contention of the Keith Railway Equipment Company is not sustained."—*Case No. 1766, Keith Railway Equipment Company versus Southern.*

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

478—*Q.—What is the purpose of the charging choke?* A.—It controls the rate of flow from the brake pipe to the quick action chamber.

479—*Q.—For what purpose are the chokes in the vent valve cylinder cover?* A.—Control the rate of exhaust of the quick action chamber air during emergency and thus provides the time interval required before release can be affected following an emergency application.

480—*Q.—What communications are open in the service lap position?* A.—Brake pipe to quick-action chamber via charging choke *27*. Brake pipe to vent-valve chamber, accelerated-release check and chamber *F* in release-insuring-valve portion. Auxiliary reservoir to release-insuring-valve portion, and auxiliary-reservoir check. Emergency reservoir to spring side of emergency valve and to outer area of emergency-valve face. Emergency reservoir to chamber above the spill-over check, and chamber over emergency slide-valve-strut diaphragm, emergency reservoir to emergency-reservoir check, and to the chamber over the emergency-reservoir charging check valve. Auxiliary reservoir to the release slide-valve chamber *D*, service slide-valve chamber *C*, release-insuring-valve portion, and to the auxiliary-reservoir check. Displacement reservoir to safety valve and the face of the emergency valve.

481—*Q.—What communications are open in the graduated-release lap position?* A.—The brake pipe to the quick-action chamber via the charging choke *27*. The brake pipe to the vent-valve chamber and chamber *F*. in the release-insuring-valve portion. The auxiliary reservoir to the release-insuring-valve portion and the auxiliary-reservoir check. Emergency reservoir to the emergency-reservoir check and to the chamber over the emergency-reservoir charging check valve. The emergency reservoir to the chamber above the spill-over check and to the chamber over the emergency slide-valve-strut diaphragm. Displacement reservoir to the safety valve, to the spring side and the face of the emergency valve, Chamber *K* on the spring side of the release piston to atmosphere, via of ports in the service slide valve and seat.

482—*Q.—What communications are open in emergency position?* A.—The quick-action chamber to the face of the vent-valve piston *42* and to atmosphere via exhaust *Z*. The brake pipe to atmosphere past the vent-valve seat. The brake pipe to the release-insuring-valve portion, the auxiliary reservoir to the displacement reservoir, to release-insuring-valve portion and auxiliary-reservoir check valve. The emergency reservoir to the displacement reservoir, by way of the emergency valve and to the emergency-reservoir check valve. The emergency reservoir to the face of the emergency valve, to the chamber over the strut diaphragm, to the chamber over the spill-over check valve, to the chamber over the back-flow check and to the chamber over the emergency-reservoir charging check valve. From the spring side of the emergency valve to atmosphere.

483—*Q.—What communications are open in the accelerated release position?* A.—The brake pipe to the quick-action chamber, to the vent-valve chamber and to the release-insuring-valve portion. Combined displacement- and auxiliary-reservoir pressure to brake pipe via accelerated-release check. Displacement reservoir to the safety valve, and to the face of the emergency valve. Emergency reservoir to the spring side of the emergency valve, to the chamber of the spill-over check and strut diaphragm and to the chamber over the emergency-reservoir check valve. Auxiliary reservoir to the chamber over the auxiliary-reservoir check valve and to the release-insuring-valve portion.

484—*Q.—What is the duty of the type B relay valve?* A.—It relays the application and release operation of the control valve, reproducing in the brake cylinder the pressure condition established.

485—*Q.—Where is the condition established?* A.—In the displacement reservoir.

486—*Q.—How does the relay valve provide for a combination of number and sizes of brake cylinders?* A.—It has a high capacity for air flow, which provides fast application and release rates for any combination of cylinders.

487—*Q.—What does the relay valve consist of?* A.—It consists of a body mounted on a pipe bracket. Mounting brackets are reversible, permitting either suspension or floor mounting of the valve.

488—*Q.—Name the operating parts of the relay valve.* A.—The relay-valve piston, the application piston, the exhaust valve and the exhaust piston.

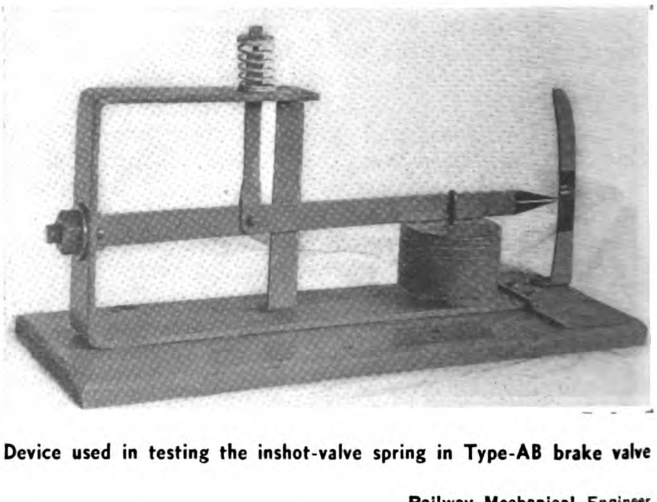
489—*Q.—How many chokes are installed in the relay valve?* A.—One, known as choke No. 12

Tool Used in Type-AB Brake Valve Maintenance

Test No. 18 of the Code of Tests covering the testing of the Type-AB air-brake valve states: "The inshot valve must close when the brake cylinder pressure is increased to not less than 12 lb. or to more than 17 lb. A lower inshot pressure than specified may be due to inshot pilot-valve seat leakage or a weak spring. A low inshot pressure may be raised by shimming the inshot valve spring."

This means that the complete valve portion has to be assembled and placed on the test rack and tested before the value of the inshot-valve spring is known; then, if shimming is necessary, the valve has to be partially dismantled, the shims applied and after the re-assembling, again placed on the test rack for a further test.

This difficulty is overcome with the device illustrated. It is a home-made affair with ¼-in. bar iron used principally in its construction, the over-all length being 18 in. and the height 8 in. The position of the weight and calibrations on the indicator will vary with each testing device made, due to various factors and should be determined by placing a spring that is known to be correct in position as shown in the illustration.



Device used in testing the inshot-valve spring in Type-AB brake valve

IN THE BACK SHOP AND ENGINEHOUSE

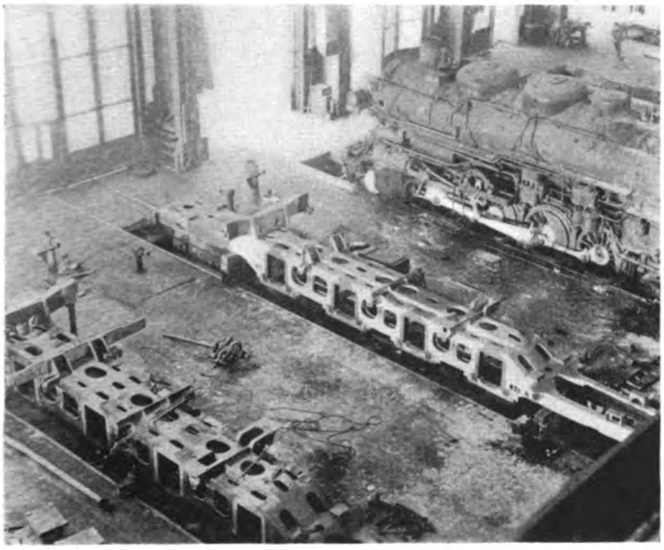
Santa Fe

Rebuilds Ten Locomotives

Heavy 4-8-4 type, 3751-class locomotives are equipped with roller bearings, Boxpok drivers and other improvements in design — How the roller bearings were installed

THE Atchison, Topeka & Santa Fe has converted ten heavy 4-8-4 type steam locomotives, known as the 3751 class, at its Albuquerque, N. M., locomotive shops. These locomotives* were purchased from Baldwin in 1928. They were originally stoker-fired, but a few years ago were changed to oil and this fuel continues in use. They will run through between La Junta, Colo., and Los Angeles, Cal., 1,235 miles. The conversion was completed in July.

The conversion work includes the following: Timken roller bearings applied to all wheels; new and longer smoke box applied; dome closed by inside cap, riveted in place; feedwater heater raised to smokebox location; reciprocating feedwater pump located under left side of cab; pressure raised from 220 to 230 lb.; two extra backhead braces and two extra flue sheet braces applied; size of radial stays around syphons increased; reinforcing pads riveted to barrel and smoke box, all rods new including tandem main rods, and new valve motion.

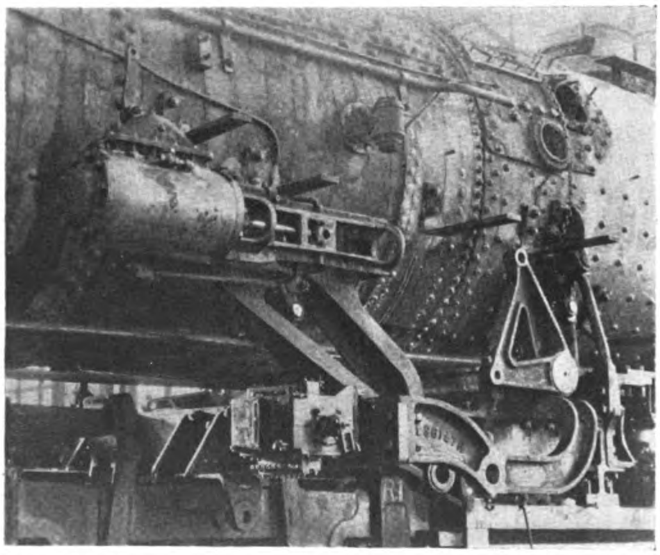


New locomotive bed castings as received from the builder

Boiler and Frames

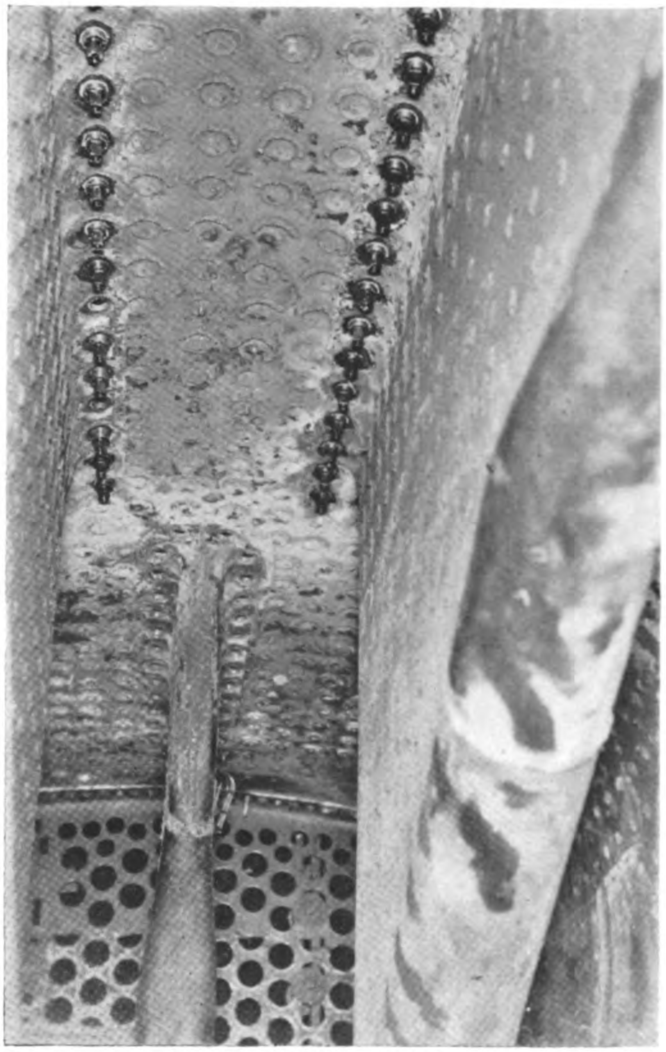
The frames are the Commonwealth locomotive bed type. The pedestal jaws are straight to accommodate the Timken bearing housings that require no wedge, but use bronze-faced shoes between the frame and the housing. In accordance with modern practice, the power reverse gear and air reservoirs are supported from the frame. The brackets for the latter are bolted to the frame and the bracket for the power reverse is included in the link bearer casting. The two belly braces are the floating type and the T-irons bear against heavy reinforcing pads riveted to the shell. The upright sheets of these braces are riveted to the T-irons and bolted to the integral cross members of the frame bed. There are three swing braces connecting the boiler and frame on each side. Two of these are on the smokebox and the other is on the shell.

In stripping, the boiler is cut loose from the cylinder saddle by burning off the heads of the bolts in the smokebox and burning out the part of these saddle bolts that extends through the smokebox. The heavy boiler work is done in the boiler shop. The original cast-steel cylinders are retained in the new design. The increase in pressure from 220 to 230 lb., necessitates two additional backhead braces and two additional back flue-sheet braces, and at this time the size of the radial stays around the siphons were increased to $1\frac{3}{16}$ in. body size. The original front-end throttle arrangement is unchanged and



The power-reverse bracket is cast integral with the link bearer

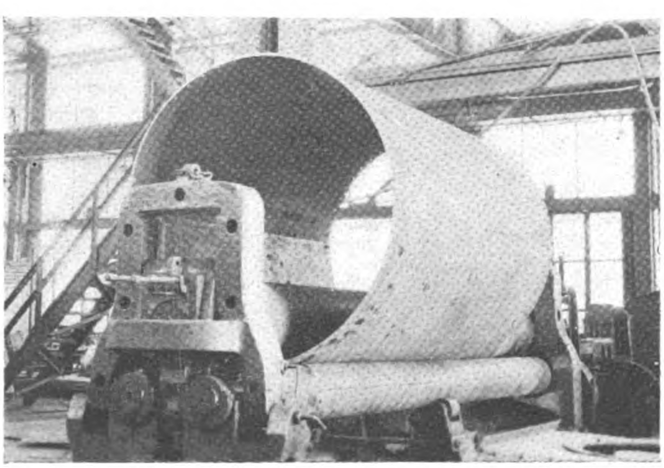
* See *Railway Mechanical Engineer*, July, 1928.



New radial stays applied around Thermic syphons—The protecting beads near the stays are to prevent cinder cutting

after the dome is permanently closed, entrance to the boiler is effected through an auxiliary dome. The original dome cap was slightly modified in shape (for clearance) and was placed inside the dome. The old stud holes in the dome are reamed and the cap riveted and caulked without the use of a gasket. This work was done while the flue sheet was out.

The increase in length of the driving-wheel base to accommodate the 80-in. drivers makes a longer boiler necessary and a new smoke box 11 ft. long was rolled and applied in the local shop. New main steam pipes are necessary between the superheater header and cylinders are several feet ahead of their former position in reference to the front flue sheet. There is little change in the draft appliances. An open-type spark arrester originally developed for coal burners by the Santa Fe test department is used with slight change on oil burners, including the locomotives of the 3751 class.



Smokebox being formed in power rolls at the Albuquerque boiler shop

Driving and Running Gear

Two outstanding additions in this connection are the change to tandem main rods, and the use of the Franklin Railway Supply Company's patented lateral-motion device on the front drivers, made necessary on account of the long driving-wheel base. The front drivers have $\frac{3}{8}$ in. total free lateral, and an additional movement of $\frac{11}{16}$ in. in either direction, against spring action, is provided by the device. The necessary slack for this movement is provided between the roller-bearing housing (boxes) and the shoes. The lateral device centers the wheels by two rollers that extend through slots in the respective spring saddles. Each roller is mounted in a block which forms the inside saddle seat and the roller bears against part of the frame. The thrust of the wheels in rounding a curve is transmitted to one of these rollers which slightly tips the spring saddle against the resistance of the driver spring. The front rod bushings have a spherical bearing in the rod to assure alinement. This device is also used on the front drivers of locomotive 5000, and many features of Santa Fe design that proved so successful on this locomotive are incorporated in the new design for the present conversion.

Inside riveted dome cap—The center of this cap has been set down (before application) by the use of a gas torch and flatter starting at a point about 8 in. from the edge

It is interesting to note that a new method has been developed for laying out the shoes which is different from the ordinary procedure in connection with shoes and wedges. This consists of squaring the frame in the usual way and locating accurately machined bars across the pedestal openings in the positions the axles will occupy. These bars are secured by small bolts to the spreaders that span the frame-jaw openings. The bars are adjusted square and in tram and the shoe thickness figured by measuring from the bars to the pedestal faces with micrometers. No prick punch marks are made on the shoes (which are not in place), but the milling-machine operator is supplied with dimensions in thousandths for each end of each shoe. The locomotive beds are accurately machined by the manufacturer and before the laying-out operation the distance between

adjacent jaws is checked by offset measuring rods. Slight irregularities are corrected by filing and grinding and the jaws are spot faced. The shoes show little difference in size when finished.

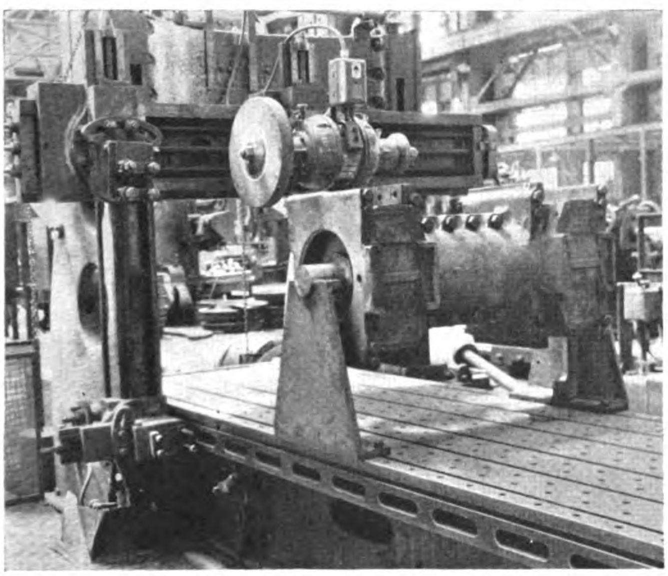
Roller Bearings

The application of roller bearings in the shop is new on the Santa Fe and is an important addition and betterment. New tenders were applied to the 3751 class locomotives at the time of change to oil and these had roller bearings as supplied by the builders. The present conversion includes roller bearings for engine trucks, trailers,

Table of Fits, in Inches, for Timken Bearings

Size of axle and location	Cone fit	Lateral adjustment of bearings	Pedestal fit
7½-in. eng. truck	.002 to .004 tight	.015 to .025 loose	1/16 loose
13½-in. main driver	.002 to .006 tight	outer set of rollers .010, inner set .012 loose	.010 to .015 loose
13 9/16-in. drivers other than main	.002 to .004 tight	outer set of rollers .010, inner set .012 loose	.010 to .015 loose
9-in. trailer	.002 to .004 tight	made at factory	1/32 loose

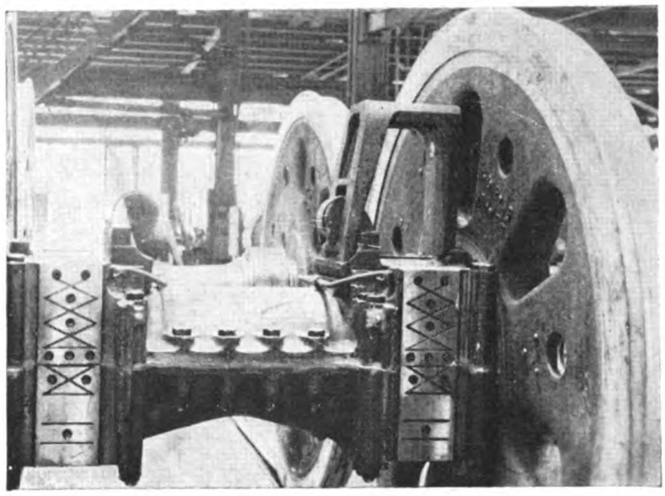
and drivers. Doing this work in the railroad shop requires the introduction of new standards of accuracy. Plus or minus .0015 in. is a common notation on the new axle blueprints, and such close tolerances on the location of the cone-backing shoulders on axles require the use of special gages. These are the template type, made by Brown & Sharpe. One of these gages has its length stenciled 37.953125 in. A full set of inside and outside micrometers up to ¼ in. is used at the axle lathe.



Special machine set-up for grinding roller-bearing housings on a planer

The axles are of Timken design with liberal-radius fillets, and the wheel fit is smooth turned and polished for an inch or more inside the hub where experience and the Timken tests show that fatigue cracks develop. The fits for the bearing cones on the journal portion of the axle are ground on a Landis grinder.

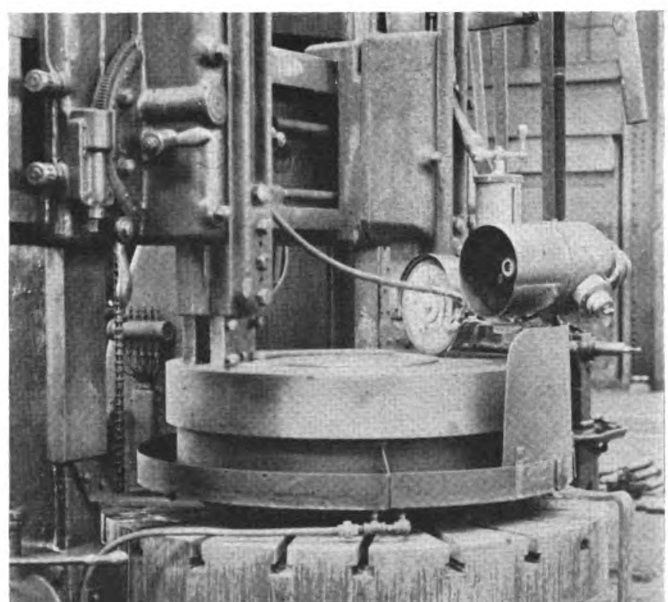
Several new wheel-press jibs and fixtures are necessary to mount these bearings. For mounting outside-journal truck bearings, a pilot sleeve is provided which fits over the axle stub. (About 1½ in. at the end of the



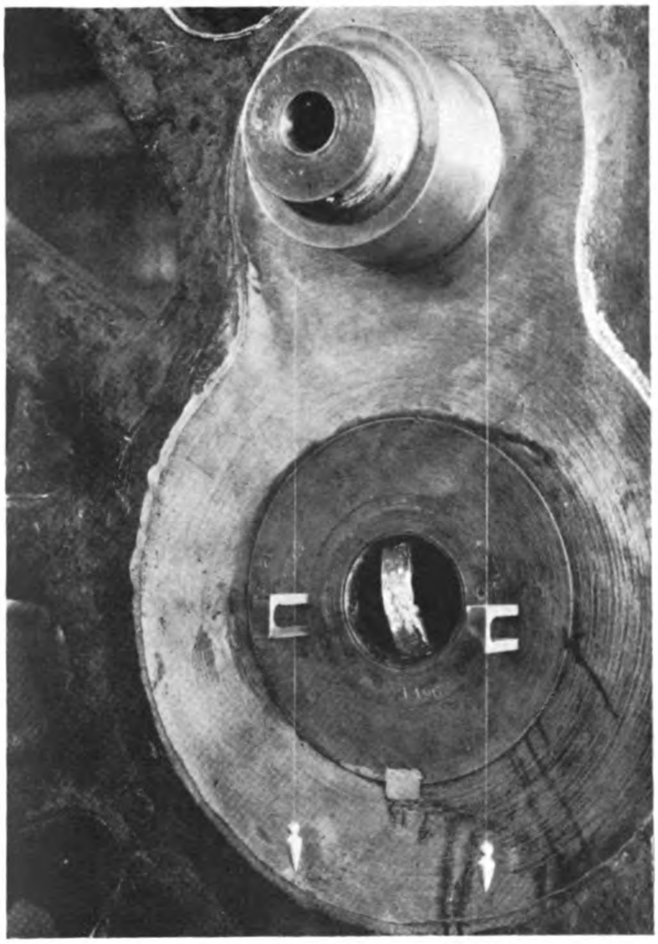
Timken roller-bearing housing in place on the front drivers—The Franklin lateral-motion device is shown on one side

axle is reduced in diameter and takes a press fit collar.) This pilot keeps the cone square as the fit enters. Heavy press fits on roller-bearing parts are not necessary or desirable. The thrust developed in rounding curves is transmitted to a shoulder on the axle, and, unlike a wheel, the bearing parts do not depend on the fit alone to hold them in position. In mounting these parts little attention is paid to tonnage except that a maximum of 25 tons is mentioned. The fit allowance is carefully checked with micrometers and the proper amount of interference with .001 in. plus or minus, is maintained. Castor oil and white lead are used as a lubricant on roller-bearing fits.

The exact procedure for mounting a Timken trailer bearing on outside journals is as follows: For shipment the parts are covered with a light coat of oil. Before mounting, this protective coating is removed by washing the parts in distillate. The mounted wheels are placed in the wheel press as if the axle were to be pressed

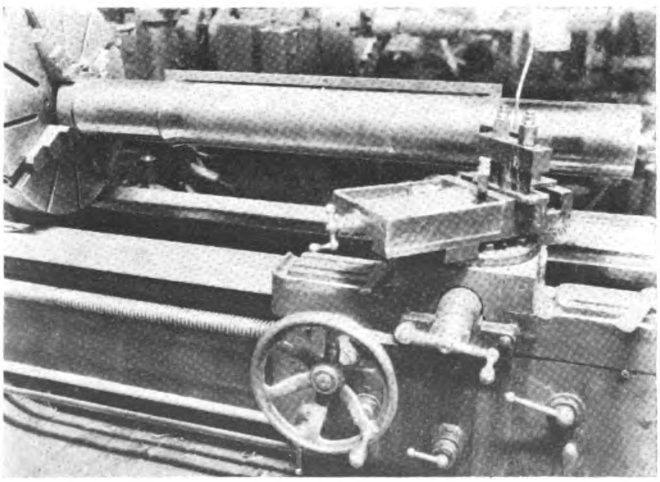


Magnetic chuck and grinder attachment used in grinding the lateral strips for Timken driver bearings on a boring mill



Magnetic squares used in counterbalancing locomotive driving wheels at Albuquerque shops

out. The enclosure (inner portion of housing) is placed over the axle against the hub with the bolts in place. This enclosure has four grooves on the inside which act as an oil seal and these are filled with valve oil to assure initial lubrication before the enclosure is applied. The oil flinger that supplements the seal is pressed in place. A freely fitting sleeve is used to press on these bearing parts. This sleeve has a spherical cap on the end toward the press ram to equalize pressure and prevent cocking the fitted parts. The first roller-bearing assembly, which includes the cone, rollers, and the flinger, is then pressed on, using the pilot fixture mentioned in a previous paragraph to start it straight. The cone spacing ring is applied next, and then the second roller bearing, after the cups are placed in position. The collar is then pressed on the end of the axle. The cup-spacing ring is in halves which may be fastened together by wire until the housing is slipped in place.



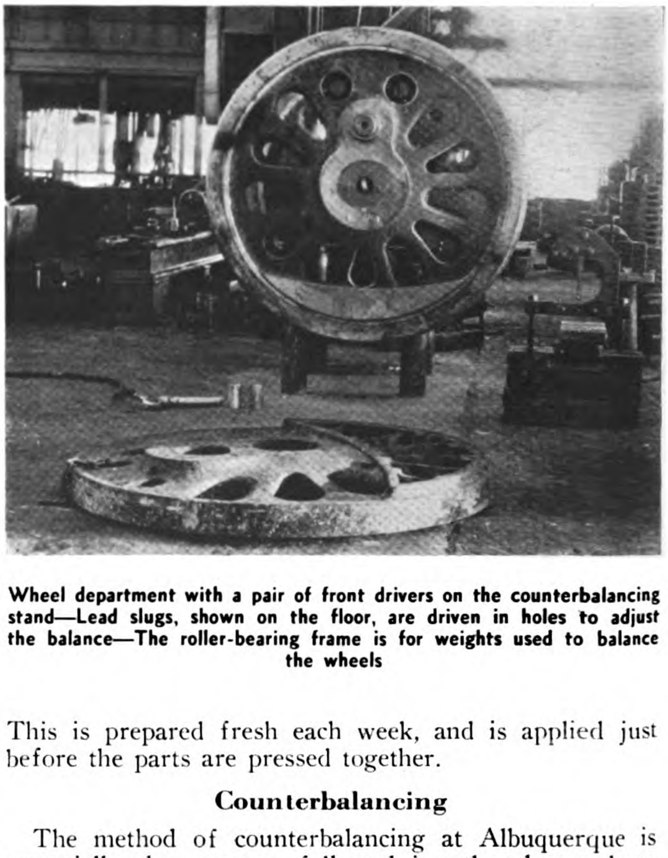
Turning one of the new axles—The gage is used to measure distance between cone-backing shoulders—The portion of each wheel fit near the inside hub face is rolled

It is interesting to note that the rollers are within .0001 in. of the same size, and this size is etched on the large end of each roller.

To check the lateral of the roller bearing, a dial indicator is used. The axle (inside journals) is turned on end preferably before the wheels are mounted and the bearing housing raised to the limit of its free motion. The load is released and the housing jarred down with a soft sledge. The dial indicator is clamped by a band around the axle and indicates the lateral movement of the housing in thousandths.

Wheel Shop Practice

Press fits on the Santa Fe are lubricated with mineral paint (box car red) mixed with boiled linseed oil. A gallon of oil is used to thin 18 lb. of brown semi plaste, which makes it about as thick as a priming coat of paint.



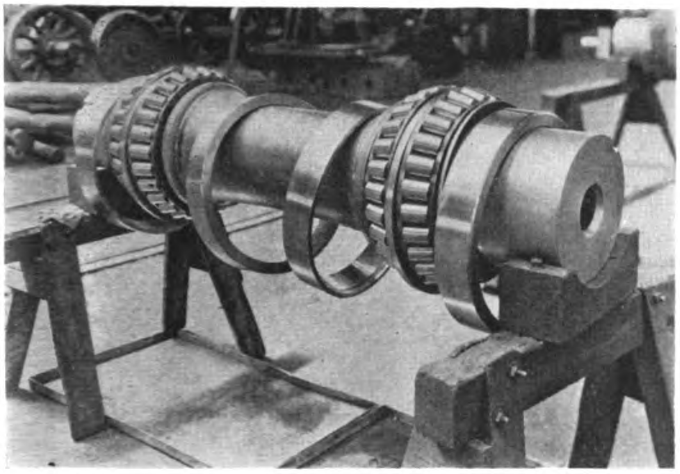
Wheel department with a pair of front drivers on the counterbalancing stand—Lead slugs, shown on the floor, are driven in holes to adjust the balance—The roller-bearing frame is for weights used to balance the wheels

This is prepared fresh each week, and is applied just before the parts are pressed together.

Counterbalancing

The method of counterbalancing at Albuquerque is essentially the same as followed in other large shops and locomotive works. The Boxpok main wheels have riveted plates covering the outside of the counterbalance space. These wheels are filled with lead before being mounted, while flat on the floor, and the lead is pounded with a long stroke riveting hammer to tighten it after it cools. All the wheels except the mains have solid steel counterweights, and three 3¼-in. holes are drilled in the back of these for slight adjustment of the balance. The main wheels have cored holes in the back of the balance for the same purpose.

The main wheels and intermediate wheels are cross-balanced, 8 deg. and 59 min. on the main and 5 deg. and



Main driver axle with roller-bearings mounted in place ready for assembly in the housing

59 min. on the number three. The counterbalances are off center this amount toward the opposite pin. When on the balancing strips, with the counterbalances properly adjusted, and the correct weight hung on the opposite pin, the main pin will be $2\frac{7}{16}$ in. out of plumb and the number three pin will be $1\frac{11}{16}$ in. out of plumb. One of the illustrations gives a view of the wheel bay where counterbalancing is done and another shows a couple of handy magnets used for squares which stick to the end of the axle and are useful in counterbalancing. After a few trials it was possible to machine the wheels so accurately that changes of less than 50 lb. (at pin radius) were required.

Babbitting Locomotive Crown Brasses

By H. C. Venter*

In order to reduce passenger locomotive failures resulting from hot driver bearings, the Southern Pacific fitted up four 4-8-2 type locomotives with oil lubrication on the driving-wheel and truck journal boxes. These four locomotives have been in continuous service long enough to demonstrate: (1) That hot driver bearings can be materially reduced; (2) that the cost of lubrication per 1,000 locomotive miles is reduced 48 per cent; (3) that there is less wear on the axles; (4) less danger of scoring the journal if a box does run hot; (5) driving boxes run much cooler when lubricated with oil.

The mechanical details of this system of oil lubrication for locomotive driving wheel and truck journals were described in the March issue of *Railway Mechanical Engineer*. Putting the crown brasses on oil made it necessary to babbitt these brasses with a suitable bearing metal, which had to possess strength, a fair ductility, a fairly high melting point and not be too easily deformed when under load. A high-tin babbitt, containing 85 per cent tin, 10 per cent antimony and 5 per cent copper, was selected for lining the crown and truck and trailer brasses, while the hub faces were lined with Satco metal.

This type of babbitt has excellent bonding characteristics and no difficulty is encountered in obtaining a firm adherent bond of babbitt to brass, and so far there has not been any case of loose linings with this high-tin babbitt, which is called copper babbitt No. 9.

The following bonding tests were made to compare the bonding strength of copper babbitt No. 9 and the standard A. A. R. babbitt as covered by the A. A. R. Specification M-501-34 wherein the tin plus antimony must not be less than 14 per cent, the balance to be lead.

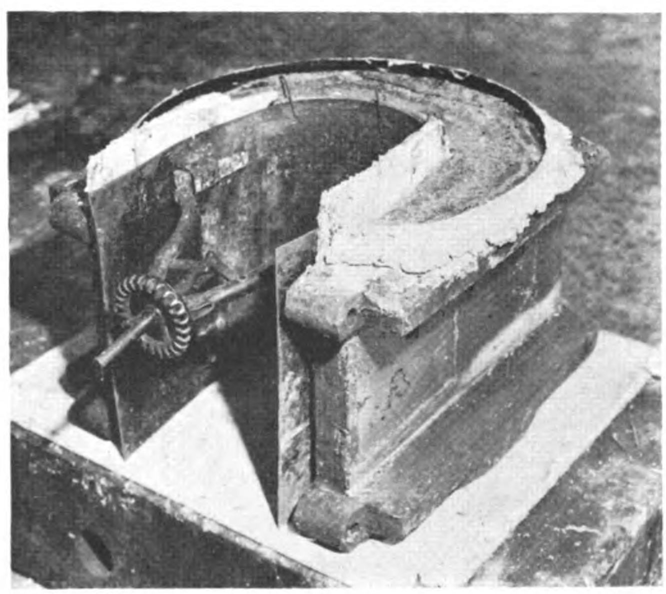
These tests bring out the fact that the bonding strength of the copper babbitt No. 9 is some 21 to 26 per cent higher than that of the A. A. R. babbitt when using the same tinning flux and the same tinning bath for both babbitts:

Bonding Strength of Babbitt to Brass

Test No.	Kind of babbitt	Tinning flux	Composition of tinning bath	Load in lb. per sq. in. to rupture bond	
1	A.A.R.	*Special	½ lead and ½ tin	6,000	
2	A.A.R.	*Special	½ lead and ½ tin	5,720	Average 5,860
3	A.A.R.	*Special	½ lead and ½ tin	5,860	
4	A.A.R.	20 per cent zinc chloride	½ lead and ½ tin	5,600	
5	A.A.R.	20 per cent zinc chloride	½ lead and ½ tin	5,720	Average 5,616
6	A.A.R.	20 per cent zinc chloride	½ lead and ½ tin	5,530	
7	Copper babbitt No. 9	20 per cent zinc chloride	½ lead and ½ tin	7,060	
8	Copper babbitt No. 9	20 per cent zinc chloride	½ lead and ½ tin	7,130	Average 7,080
9	Copper babbitt No. 9	20 per cent zinc chloride	½ lead and ½ tin	7,050	

* Special tinning solution consisting of zinc and tin chlorides.

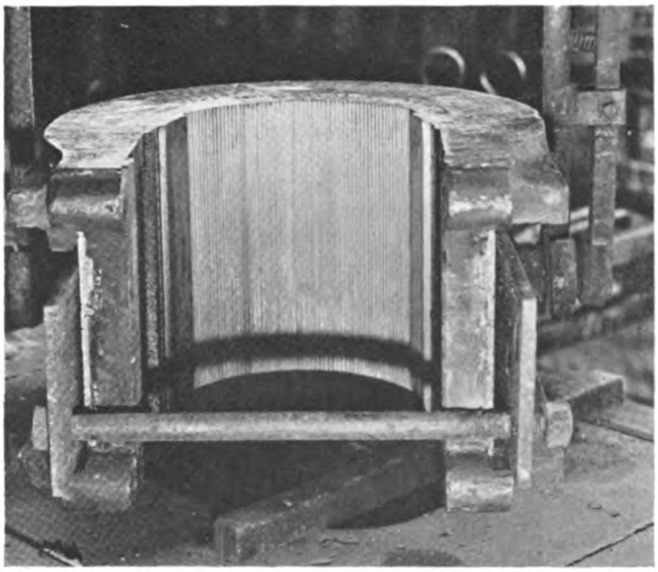
The crown brasses are notched, as illustrated, to obtain a greater bonding area and are then pressed into the box before babbitting. The whole assembly is prewarmed and a zinc chloride tinning solution is then applied to the hub face and the notched part of the brass. The box is placed in the tinning bath with the hub face on the bottom, the bath being maintained at a temperature of 540 deg. F. A small hand ladle is used to



Sheet-metal form and hand-screw expander used in preparing a driving-box hub face for pouring the babbitt

dip up and pour the tinning metal over the exposed grooves of the brass. After standing in the bath for three to five minutes, the box is turned upside down, thus exposing the tinned hub face; tinning metal is again

* Shop superintendent, Southern Pacific, Sacramento, Cal.



Notched crown brass being pre-warmed preliminary to tinning

poured over the grooves and the whole grooved surface is thus tinned. When properly done, the tinning metal will evenly distribute itself over the grooved surface.

After removing from the tin bath, a tinned brass wire screen is spot brazed in eight places to the hub face. These spots are tinned by applying zinc chloride tinning fluid and rubbing with a stick of solder, there being enough heat in the box to melt the solder. The hub face is then babbitted with Satco metal which is poured at a temperature of approximately 1,050 deg. F. To assure a bond between the Satco babbitt on the hub face and the copper babbitt No. 9 of the crown brass, zinc chloride tinning fluid is applied to the inner edge of hub face nearest to the axle.

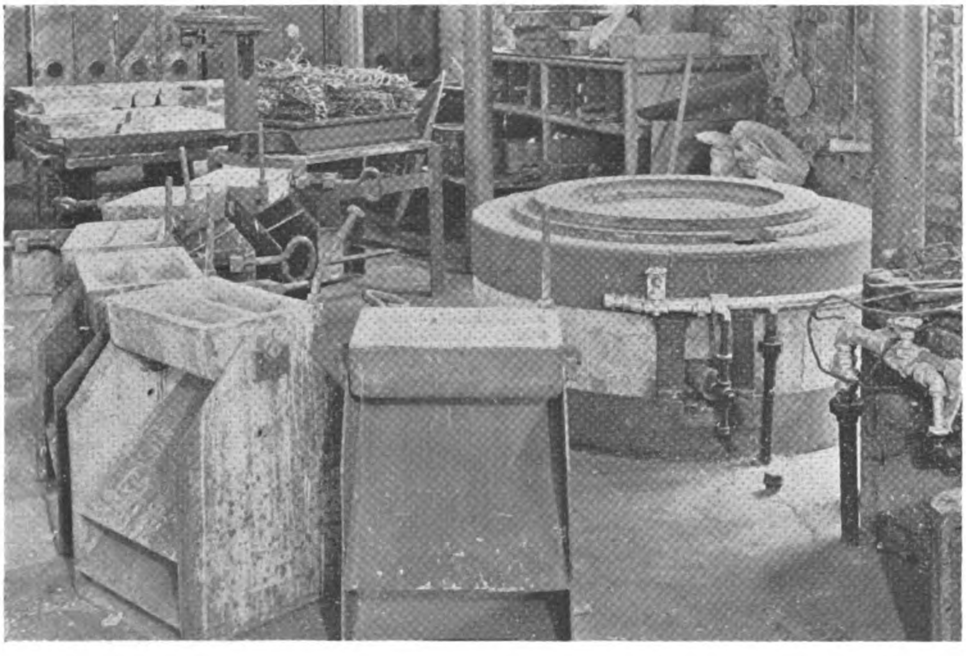
The box still being sufficiently warm, the crown brass is then babbitted with copper babbitt No. 9, which is poured at a temperature of 800 to 830 deg. F.

A tilting device was developed so that these boxes could be safely and conveniently handled. It consists of a U-shape steel frame, made of 1-in. by 6-in. stock, with a 1-in. hole near the end of each leg in order that a long bolt may be inserted and thus close up the open end. On each side of the U-frame, a trunnion is welded in place and a ring welded to the outer end of each trunnion to prevent the one-piece forged-steel bail, made of 1-in. round bar stock, from spreading or slipping off.

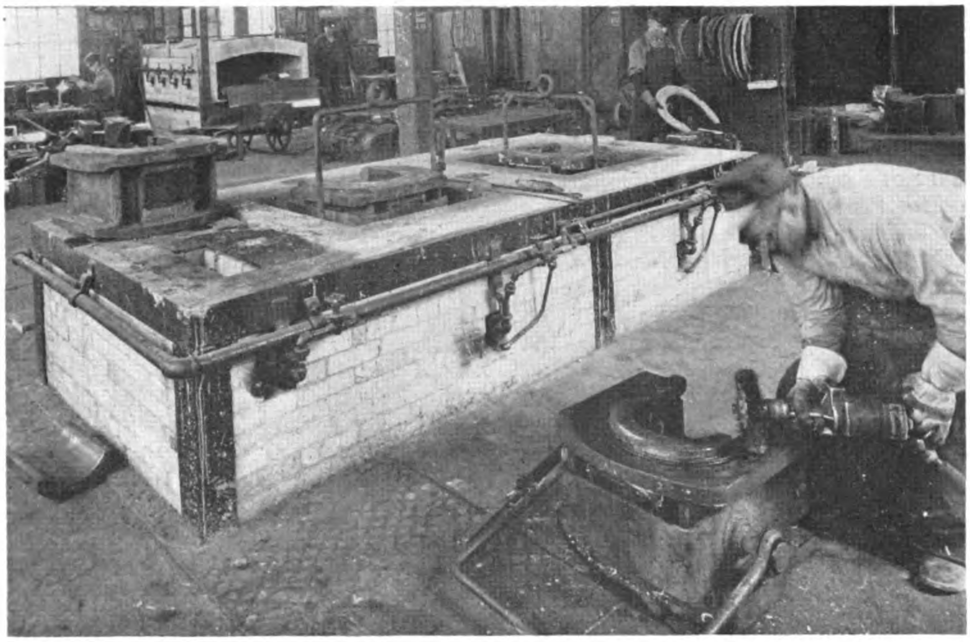
The interesting feature of this device is that it can be spun around on the trunnions through 180 deg. at which point it always locks itself in the horizontal position.

Driving box poured with copper babbitt No. 9 on the crown brass and Satco metal on the hub face

This is accomplished by a vertical key-bar, connected to one side of the bail, as illustrated, and designed to engage a slot in the trunnion end. A small coil spring, located 3 in. above where the key-bar is attached to the bail forces the upper end of the bar outward and away



Oil-fired furnace and equipment used in making copper babbitt No. 9



Furnace equipment used in heating and tinning driving boxes preparatory to babbitting

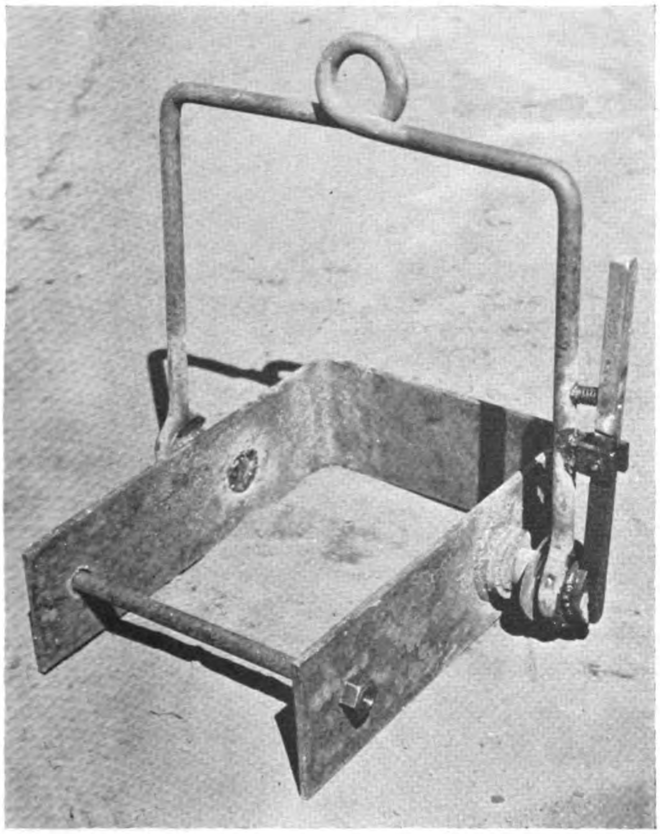
from the bail, while the other end is pressed against the trunnion which is slotted to receive the bar.

Thus it can be seen that the bar is held in place by the spring which acts to keep the bar always bearing against the trunnion. The spring is made so that a moderate pressure of the hand on the top of the bar will compress the spring and release the trunnion.

The Southern Pacific manufactures its own high-tin babbitt (copper babbitt No. 9), using only the purest grades of tin, antimony and copper. The copper used is electrolytic sheet copper, or clippings and punchings from new sheet copper, which are satisfactory if clean, and reduce the cost of this item.

To make this babbitt, the tin is first melted under a cover of charcoal, and when the temperature rises to 700 deg. F., the copper is added. At this point sal-ammoniac is added which aids in cleaning up the oxides on the surface of the metal and causes the surface of the copper to tin, and once tinned it rapidly alloys with the tin above 750 deg. F.

It may be of interest to note that below 700 deg. F. the copper alloys slowly with tin, while at 800 deg. F. it is readily alloyed. Five per cent of copper in sheet form can be alloyed in approximately ten minutes. After the copper is all alloyed the antimony is added in small pieces about the size of a walnut, and the metal held between 800 and 850 deg. F., with frequent stirring until the antimony is alloyed, which will take a little longer than in the case of the copper. The metal is then skimmed and poured into 25-lb. pigs and is stored for future use.



Driving-box holder which may be indexed to either of two 180 deg. positions

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Locating the Center of Circular Disks

Q.—What is a simple method for obtaining the centers of circular disks?—M. J. F.

A.—For small disks, up to 24 in. in diameter, a con-

venient method is to place an ordinary steel square on the disk with the corner of the square flush with the edge of the disk and then draw lines along the two sides of the square until each intersects the edge of the disk. These two lines will form the two sides of a right-angle triangle. From the points where the lines intersect the edge of the disk draw a third line forming the hypotenuse of the triangle. Repeat this process, moving the square around the disk about 90 deg. each time, until three triangles are formed on the disk. The point of intersection of the hypotenuse of the three triangles thus formed is the center of the disk.

When a square is not available the same idea can be accomplished by the use of dividers. Open the dividers any convenient distance and with one leg held exactly at a point on the edge of the disk, describe two short arcs, across the edges of the disk, both points on the edge of the disk. Then, with the dividers open a little further, place one leg in succession at each of the points marked on the edges of the disk and describe two short arcs which will intersect near the edge of the disk opposite the point of beginning. The first point is connected with a line to the intersection just made. Then select another point on the edge of the disk at about 90 deg. from the first point. Repeat the operations from the second point and where the two lines intersect will be the required center of the disk.

Hand Rails Extended to the Head-Log Casting Break When Securely Fastened

Q.—We have had considerable trouble with the handrails of our Pacific-type locomotives when they are extended down from the side of the boiler to the bumper deck. We find the handrails broken where they enter the fitting on the bumper deck. What is the cause of this trouble and can it be remedied?—A. F. D.

A.—The breaking of the handrails is probably due to the expansion and contraction of the boiler. I assume that the handrails are securely fastened to the side of the boiler and set down into a typical handrail bracket on the bumper deck. With this arrangement the movement of the boiler is transmitted to the handrail, and carried down to the bumper deck, which however, does not expand or contract with the boiler. This movement causes a strain on the handrail just above the point where the handrail enters the handrail bracket on the bumper deck, causing the handrail to fracture at this point.

This condition can be remedied by freeing the handrail so that the strains set up due to the expansion and contraction of the boiler are eliminated. This can be done by freeing the handrails in the handrail columns and bumper deck casting, or providing a slip joint in the handrail itself.

A Boiler Problem — Prize Competition

The accompanying drawing and text describe the boiler patch selected by the judges as the winner of the second prize in the competition announced in the March issue. It was submitted by J. E. Harrison, general boiler foreman, Central of Georgia, Macon, Ga.

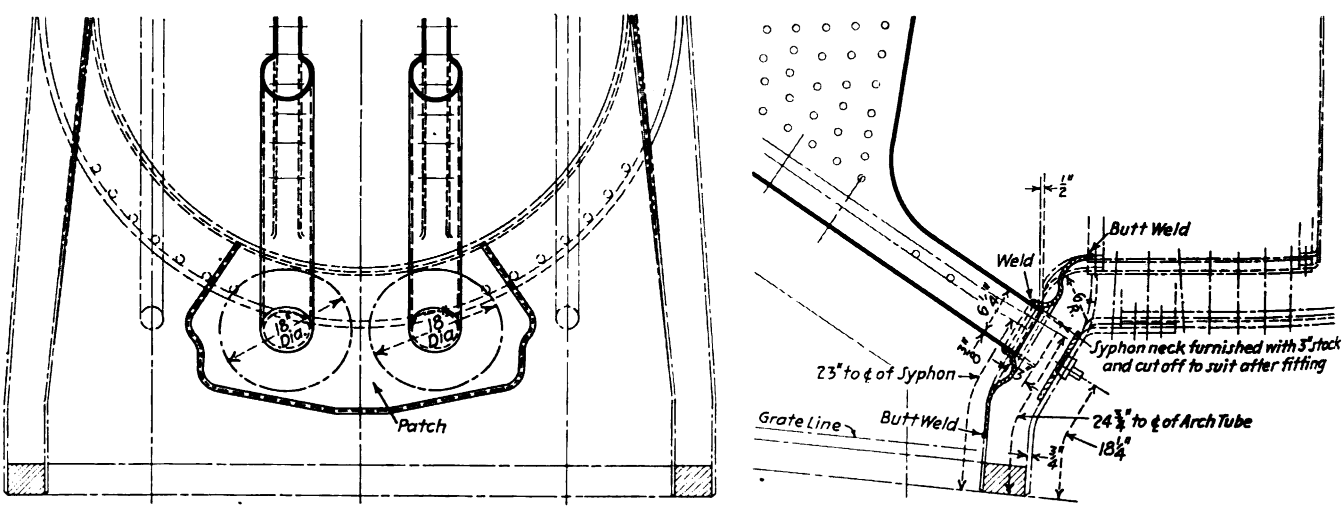
The accompanying drawing shows a firebox throat-sheet patch as applied to a 4-8-2 type locomotive boiler, equipped with syphons.

The problem of patching a firebox at the throat sheet, where the patch is extended to the combustion chamber, is always a difficult one, due to the irregular shape of the patch. In this case, the patch was even more difficult due to the fact that it not only had to be shaped and fitted to the contour of the throat at the combustion chamber, but also had to be lined up to fit the necks of the syphons as well.

After the patch was flanged to shape, the greatest difficulty was experienced in fitting it to the firebox, due to the fact that a patch in this location is extremely hard to hold in place while making final adjustments in the shape of the patch. With an ordinary patch, it is possible to bolt it in place while fitting it to the boiler. With this type of patch the only means of holding it was through the staybolt holes.

The patch was applied by working from the bottom up. It was first lined up along the bottom and then fitted over the necks of the syphons and held in place through the staybolt holes. It was then fitted to the contour of the combustion chamber. This was a difficult part of the job due to the fact that after setting the patch in place, it was only possible to work on it from one side of the plate while flanging it to fit the combustion chamber.

Under the flanging conditions it was not only necessary to keep the "OG" in shape but also line it up with the necks of the syphons while maintaining the proper angle of the inside throat sheet. After fitting the patch in place it was butt welded all around using $\frac{5}{32}$-in. electrodes.



The irregular shape of this throat-sheet patch, around two syphon necks, presented a difficult problem in application

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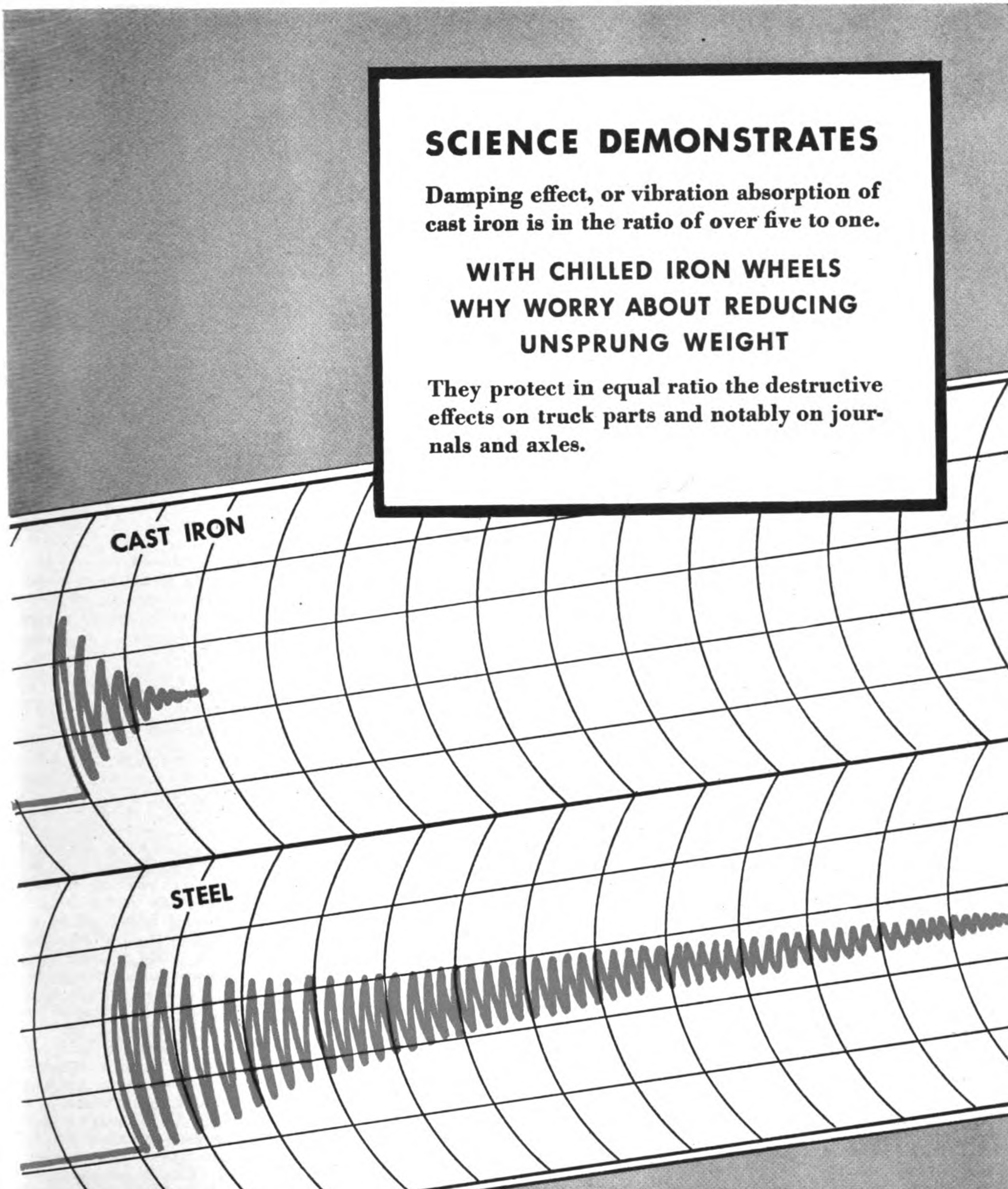
SCIENCE DEMONSTRATES

Damping effect, or vibration absorption of cast iron is in the ratio of over five to one.

WITH CHILLED IRON WHEELS WHY WORRY ABOUT REDUCING UNSPRUNG WEIGHT

They protect in equal ratio the destructive effects on truck parts and notably on journals and axles.



ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

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NEW YORK, N. Y.

445 N. SACRAMENTO BLVD.,
CHICAGO, ILL.

AMCCW

ORGANIZED TO ACHIEVE:
- **Uniform Specifications**
- **Uniform Inspection**
- **Uniform Product**

High Spots in

Railway Affairs . . .

More Railroad Jobs

Railway employment increased from 991,900 in mid-June of this year to 1,002,135 in mid-July. This latter figure is a decided increase over that for July of last year—7.7 per cent to be exact. The largest percentage increase came in the maintenance of equipment and stores group, 13.34 per cent, but was very closely followed by the maintenance of way and structures group, with a 13.32 per cent increase. If we take an index figure of 100 for the average railway employment for July in 1923-25, then the index figure on July 15 last year was 50.8 and for mid-July this year, 54.7.

People Don't Want Government Ownership

In commenting in a radio address upon the accomplishments of the recent session of Congress, House Majority Leader Rayburn said, "I do not believe that the American people want government ownership of railroads. I certainly do not. One of the surest ways to prevent it is to enact fair and just transportation legislation that will bring under government control all instrumentalities of interstate commerce. * * * The recent session of Congress—both House and Senate—approved of legislation to bring under regulation all forms of transportation in an effort to stop cut-throat competition and have a well rounded transportation set-up in the country. These bills are now in conference between the House and the Senate and it is the hope that an efficient, workable law will come out of these deliberations."

Prize Winning Name

More than three-quarters of a million entries were received in the contest sponsored by the Pullman Company for a name for a roomette car on exhibition at the New York World's Fair. American Mile Master proved to be the winning name. The most popular names suggested were Magic Carpet, Mercury, Silver Streak and Travel Ease. During the last three days of the contest, which extended from April 25 to June 15, a quarter of a million entries were received. A force of more than 100 people was required to sort, file and index the names. The contestants whose 25 names were selected by the judges were each given a pair of trips to either the New York or the San Francisco Fair. In addition, those who included with their entries the correct rail and Pullman fares to the exposition they preferred to visit, were given $200. in spending money. Five hundred consolation prizes of one dollar each were also awarded. To each ticket agent or ticket seller whose names appeared on the entry blanks of the major prize winners, $25. was given.

Suggestions For Improvements

An Employees' Suggestion System was inaugurated by the Illinois Central on March 6 of this year. Between that date and July 20 employees of the road turned in 6,650 suggestions for the reduction of costs or improvements in the service. Allowing for those who sent in more than one suggestion, it is said that one out of every five employees contributed ideas. The suggestions are made on numbered cards, which are unsigned, the employees retaining the stubs of the cards on which the suggestions are made. Cash awards have been given thus far for 232 suggestions and at least 100 more are being studied to determine their practicability. The numbers of those suggestions which are given awards are announced in a weekly bulletin and the winners present the stubs to claim these awards. The general suggestion committee includes a representative of the organized employees and representatives of the major departments of the railroad.

Texas Prohibits Sunday Trucks

More and more are automobilists taking to the highways over the weekends and on holidays—and how they do cuss the unwieldy motor trucks that block the roads and shut off the landscape ahead! Frequently the truck drivers are strangely thoughtless and indifferent to the convenience of those behind them, when a little courtesy on their part would help the traffic movement and do much to smooth the ruffled feelings of the pleasure car drivers. The worm will turn, however, as is indicated by the action of the Railroad Commission of Texas in prohibiting operation of commercial trucks upon the trunk highways of that state on Sundays and holidays. The order indicates that its purpose is the protection of human lives. It does not apply to farmers and other private operators who own their trucks, and exceptions are also made for trucks transporting fresh meats, fish, poultry, poultry products, milk and dairy products, fresh fruits and vegetables and any commodity requiring refrigeration in transit.

S.2009 Lost In the Shuffle

We had high hopes that S.2009, the railroad bill that seemed to afford some promise of real relief to the railroads, would be enacted. It passed the House so late, however, July 26, and was so different from the bill of the same number that had been passed by the Senate, that there was no time to adjust it in conference and secure the approval of the two houses. Moreover, high pressure propagandists of special interests had been able to secure modifications in the original bills which greatly decreased their effectiveness from the standpoint of the public welfare and of giving real relief to the railroads. It is proposed now to have the conferees get together some time in December in an effort to frame a conference report for presentation early in the next session of Congress. Let us hope that they will do a statesmanlike job and not be swayed by self-seeking propagandists.

Little Railroad Legislation Enacted

The railroad question in its present aggravated form is not a new one by any means. It seems to be generally admitted that it is a pressing problem of first importance from the viewpoint of national welfare, but Congress never seems to find time to do anything really worth while about it. Yes, there were lots of hearings and much talk at the session which adjourned on August 5, but out of it all came the enactment of only a few relatively unimportant bills. One of these was the Chandler voluntary railroad reorganization bill, which gives legal sanction to such plans for readjustments of capital structures as have been worked out by the Baltimore & Ohio and the Lehigh Valley. There was also an amendment to Section 77 of the Bankruptcy Act, to provide that personal injury claims of employees of roads in reorganization shall be charged to operating expenses. The R. F. C. lending powers were also extended to June 30, 1941. Certain amendments were made to the Railroad Unemployment Insurance Act to facilitate the administration of that law. The general tax bill embodied potential sources of relief for the railroads in those provisions for the repeal of the undistributed profits tax and those which will permit roads in financial difficulties to purchase their own obligations at a discount, without being liable for capital gains taxes on paper profits. While these measures are not unimportant, they hardly scratch the surface, so far as real relief from unfair conditions is concerned.

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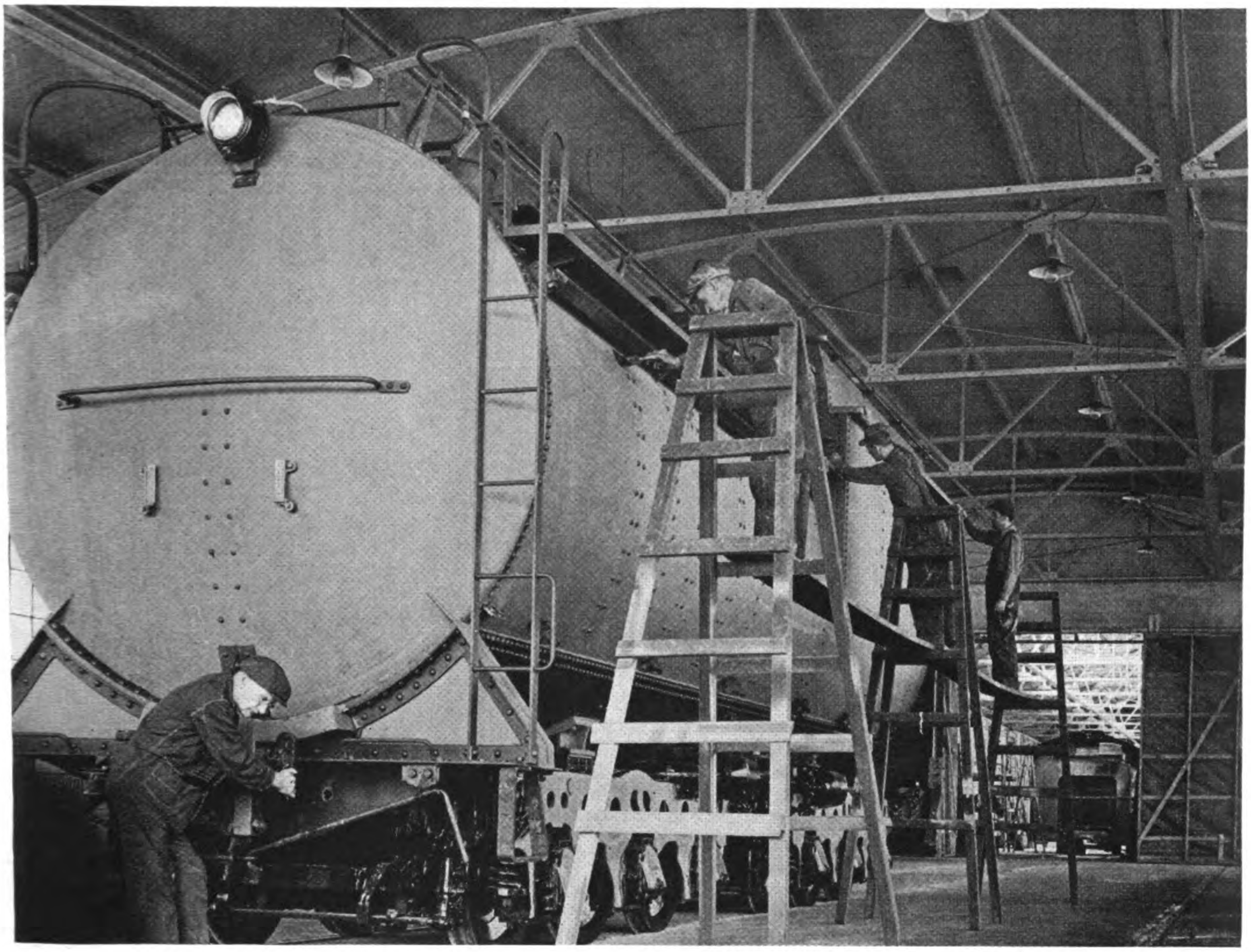
METHODS AND MACHINERY THAT GUARD LIMA QUALITY



GOOD LOOKS . . . *is good business*

In a light and airy paint shop, the modern locomotive gets the finishing touch.

And in these days when styling and appearance are important in building traffic and public acceptance, Lima is justly proud of its paint work.

Proper ventilation and temperature for uniform drying were particularly sought after in building this shop.

As a result, the final appearance of Lima locomotives does credit to the unseen workmanship that makes quality of performance.

LIMA LOCOMOTIVE WORKS, LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

Among the Clubs and Associations

Northwest Car Men's Association.—Meeting held September 6 at St. Paul, Minn. Open discussion on questions and problems of car inspectors and car repairers.

Car Foremen's Association of Chicago.—Meeting at 8 p.m., September 11, at the La Salle Hotel, Chicago. Open meeting night for the discussion of car-department problems.

Toronto Railway Club.—Meeting 8 p.m., September 25, Royal York Hotel, Toronto. A paper on the Handling of Dangerous Articles in Transportation, will be presented by A. H. McMullen, inspector, Bureau of Explosives.

British-American Engineering Congress.—The joint meeting of the British Institution of Mechanical Engineers, the American Society of Engineers, the American Society of Civil Engineers, and the Engineering Institute of Canada, scheduled for September 4-8 at New York, and all functions in connection therewith were cancelled on August 26 because of the inability of many of the British engineers to visit America while unsettled conditions prevail in Europe. Arrangements for the presentation of the technical papers prepared for this meeting will be announced later.

Pacific Railway Club.—At a meeting called especially to consider the matter, the board of governors of the Pacific Railway Club recently decided to increase the club's activities by conducting monthly meetings alternately in northern and southern California, and by amending the club's constitution so that commencing with the next fiscal year there will be an increase in the number of vice-presidents from two to four, two of whom will be from each portion of the state. With about 40 members in southern California the club has been holding one meeting each year in Los Angeles, usually in September. ¶It is now proposed to engage in a campaign to bring the southern California membership to a total of at least 150, and with the additional revenue thus obtained to hold at least four, and possibly six, meetings there. While the holding of these meetings in Los Angeles will necessarily mean fewer meetings in San Francisco, all members will receive the transcripts of all meetings in the club's monthly publication, and it is believed that many of the club members will attend meetings in both parts of the state. ¶The first meeting in Los Angeles will be Friday evening, September 15, at the Hotel Hayward.

High-Speed Trains

A regional meeting of the Society of Automotive Engineers to be held in Chicago on October 6 will be devoted to the discussion of highspeed streamline trains. The speakers include Carl R. Gray, Jr., executive vice-president of the Chicago, St. Paul, Minneapolis & Omaha, and Col. E. J. W. Ragsdale, chief engineer of the Edward G. Budd Manufacturing Company. An inspection trip to the Chicago & North Western's facilities at Sacramento and California avenues, Chicago, is also included in the program.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

Air-Brake Association.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

Allied Railway Supply Association.—J. F. Gettrust, P. O. Box 5522, Chicago.

American Society of Mechanical Engineers.—C. E. Davies, 29 West Thirty-ninth street, New York.

Railroad Division.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

Machine Shop Practice Division.—Erik Aberg, editor, Machinery, 148 Lafayette St., New York.

Materials Handling Division.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

Oil and Gas Power Division.—M. J. Reed, 2 West Forty-fifth street, New York.

Fuels Division.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

Association of American Railroads.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

Operating Section.—J. C. Caviston, 30 Vesey street, New York.

Mechanical Division.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Annual meeting, June 28, 29 and 30, at the Commodore Hotel, New York.

Purchases and Stores Division.—W. J. Farrell, 30 Vesey street, New York.

Motor Transport Division.—George M. Campbell, Transportation Building, Washington, D. C.

Canadian Railway Club.—C. R. Crook, 4468 Oxford avenue, N. D. G., Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Department Association of St. Louis.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, DeSoto Hotel, St. Louis, Mo.

Car Department Officers' Association.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago. Meeting, October 17, 18 and 19, Hotel Sherman, Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

Central Railway Club of Buffalo.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

Eastern Car Foremen's Association.—Roy MacLeod, Room 127, General Office Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of January, February, March, April and October at Engineering Societies Bldg., 29 West 39th street, New York.

Indianapolis Car Inspection Association.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

International Railway Fuel Association.—See Railway Fuel and Traveling Engineers' Association. Meeting third week in October, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—See Locomotive Maintenance Officers' Association.

Locomotive Maintenance Officers' Association.—F. T. James, division master mechanic, D. L. & W., Hoboken, N. J.

Master Boiler Makers' Association.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Annual meeting, October 17, 18, and 19, Hotel Sherman, Chicago.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August, September and December at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, 1931 University avenue, St. Paul.

Pacific Railway Club.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Monthly meetings alternately in northern and southern California.

Railway Club of Greenville.—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

Railway Fuel and Traveling Engineers' Association.—T. Duff Smith, 1255 Old Colony building, Chicago. Annual meeting October 17, 18, and 19, Hotel Sherman, Chicago.

Railway Supply Manufacturers' Association.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November. Ansley Hotel, Atlanta, Ga.

Toronto Railway Club.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

Traveling Engineers' Association.—See Railway Fuel and Traveling Engineers' Association.

Western Railway Club.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

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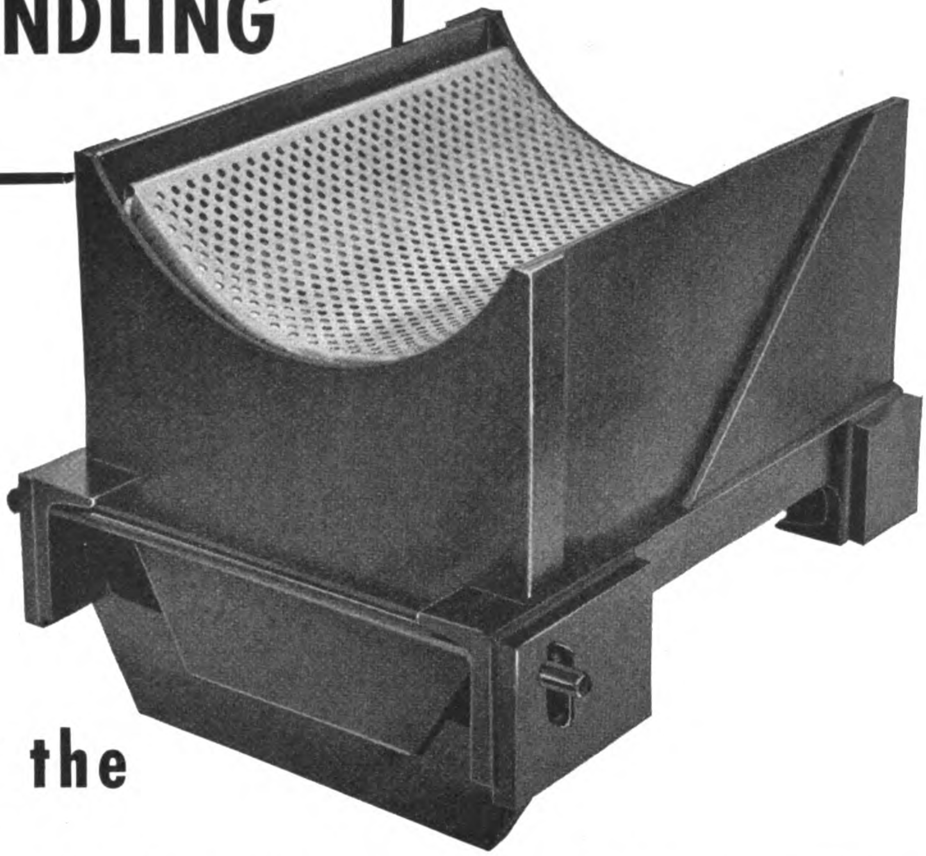
FOR EASE OF MAINTENANCE AND HANDLING



Specify the

No. 8 Combined Lubricator and Spreader

The New reversible cellar of the Franklin No. 8 Combined Lubricator and Spreader weighs less than half of the old cast steel cellar; yet its design assures an even better lubricating job. This fabricated steel unit, in which the hub end wall is integral with the spreader, makes possible a light, open-end cellar which brings the perforated plate closer to the hub. » » » Despite the drastic reduction in weight, the fabricated steel construction effectively eliminates the possibility of the jaws of the driving box closing in and pinching the cellar. For new power or replacements, specify the Franklin No. 8 Combined Lubricator and Spreader and secure better lubrication with a minimum of weight.

FRANKLIN RAILWAY SUPPLY COMPANY, INC. NEW YORK CHICAGO MONTREAL

NEWS

New Books—A Correction

"MACHINE DESIGN" reviewed on page 322 of the August issue of the *Railway Mechanical Engineer* can be obtained at a cost of $3, rather than $5 as mentioned therein.

Equipment Depreciation Rates

EQUIPMENT depreciation rates for nine railroads, including the Minneapolis & St. Louis and the Detroit & Toledo Shore Line, have been prescribed by the Interstate Commerce Commission, in a new series of modifications of previous sub-orders in No. 15,100, Depreciation Charges of Steam Railroad Companies. The composite percentages for all equipment, which are not prescribed rates, range from 2.55 per cent for the Staten Island Rapid Transit to 10.8 per cent for the Augusta Northern.

The M. & St. L.'s composite percentage of 3.43 is derived from prescribed rates as follows: Steam locomotives, 3.02 per cent; other locomotives, 3.26 per cent; freight-train cars, 3.46 per cent; passenger-train cars, 4.26 per cent; work equipment, 4.79 per cent; miscellaneous equipment, 14.82 per cent. The Detroit & Toledo Shore Line, with a composite percentage of 3.89, gets prescribed rates as follows: Steam locomotives, 3.93 per cent; freight-train cars, 3.74 per cent; work equipment, 4.46 per cent.

New Equipment Orders and Inquiries Announced Since the Closing of the August Issue

LOCOMOTIVE ORDERS

Road	No. of Locos.	Type of Loco.	Builder
Maine Central	2	600-hp. Diesel-elec.	American Loco. Co.
United States Navy Dept.	1	50-ton Diesel-elec.	Atlas Car & Mfg. Co.

LOCOMOTIVE INQUIRIES

Road	No. of Locos.	Type of Loco.	Builder
Panama Canal	5 or 10[1]	2-6-0	
Southern New York Rwy, Inc.	1	40- or 50-ton Gasoline or Diesel-elec.	

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
American Refrig. Transit Co.	100	Refrigerator	Company Shops
B. & O.	180[2]	Auto	Company Shops
N. Y., C. & St. L.	10	110-ton gondola type containers	Pullman-Std. Car Mfg. Co.
	25	70-ton covered hoppers	American Car & Fdry. Co.

FREIGHT-CAR INQUIRIES

Road	No. of Cars	Type of Car	Builder
C. & O.	2,000	50-ton hopper	
	400	50-ton gondola with steel floors	
	100	50-ton gondola with wood floors	
C. & N. W.	500	70-ton hopper	
	300	50-ton furniture	
Minn. & St. Louis	35	40-ton automobile	
N. Y., N. H. & H.	250	50-ton hopper	
Virginian	500	55-ton hopper	

[1] Purchase contemplated.
[2] Steel double-door type, to be built at Cumberland, Md., and Keyser, W. Va.

NOTES: *The Union Pacific*, the *Southern Pacific* and the *Chicago & North Western* plan to purchase two 17-car streamlined trains with delivery early next year. One of the trains will be used between Chicago and San Francisco, Cal., and the other between Chicago and Los Angeles.

The New York, Susquehanna & Western has applied to the federal court in New Jersey for permission to purchase two streamline high-speed air-conditioned rail-motor cars, for service between New York and Paterson, N. J., and Butler, the cars to be equipped for double-end operation by two-man crews and afford seats for 78 passengers.

Auto-Loading Devices Installation

THE Missouri Pacific has been authorized by the federal district court to modernize automobile loading devices on 200 automobile box cars at an estimated cost of $84,205.

11,351 Air-Conditioned Cars

CLASS I railroads and the Pullman Company had 11,351 air-conditioned passenger cars in service on July 1, according to reports received by the Association of American Railroads and made public August 24. Of that number 6,327 belong to Class I roads and 5,024 belong to the Pullman Company. In the year ended on July 1, 548 passenger cars were air-conditioned, of which 465 were owned by the railroads and 83 by the Pullman Company.

"As a result of the increase that has taken place in the past few years in the number of air-conditioned cars, practically all the through passenger trains in every part of the United States are now air-conditioned," the A. A. R. statement says.

Rack-Rail Diesel-Electric Locomotive for M. & P. P.

THE first rack-rail Diesel-electric locomotive built by the General Electric Company, Schenectady, N. Y., for the Manitou & Pike's Peak Railway, the highest cog railway in the world, replaces the tilted steam locomotives which for almost fifty years have been pushing sightseers to the summit of this famous mountain.

Contrary to ordinary practice, the 50-passenger car on this unique railway is pushed rather than hauled by the locomotive. The new Diesel-electric locomotive is arranged to provide traction at the wheels as well as the rack-rail, but not simultaneously. It has two axles, weighs 20 tons, and is powered by three Diesel-electric generating units. Each unit is rated 160 hp. at 1,800 ft. above sea level, but at the top of Pike's Peak, at an eleva-

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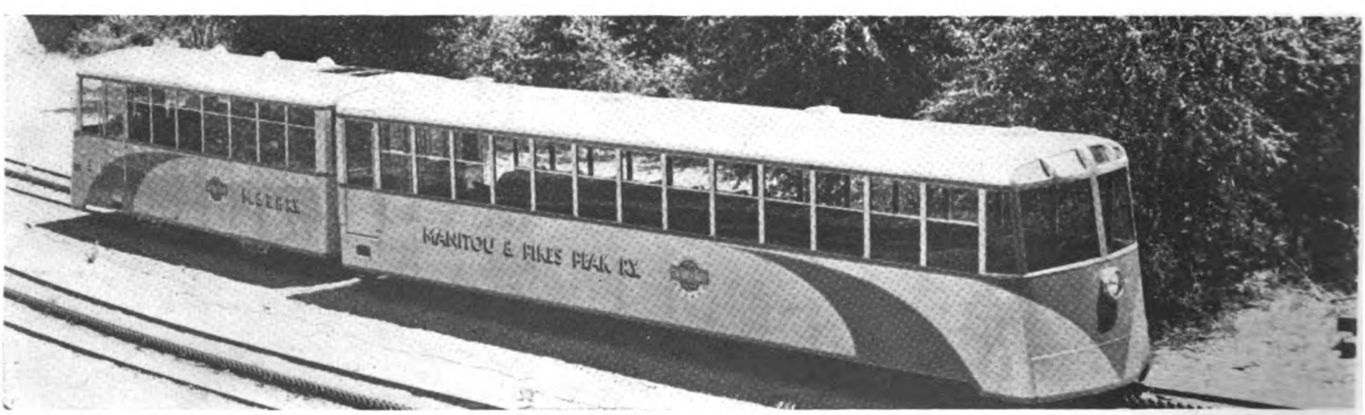
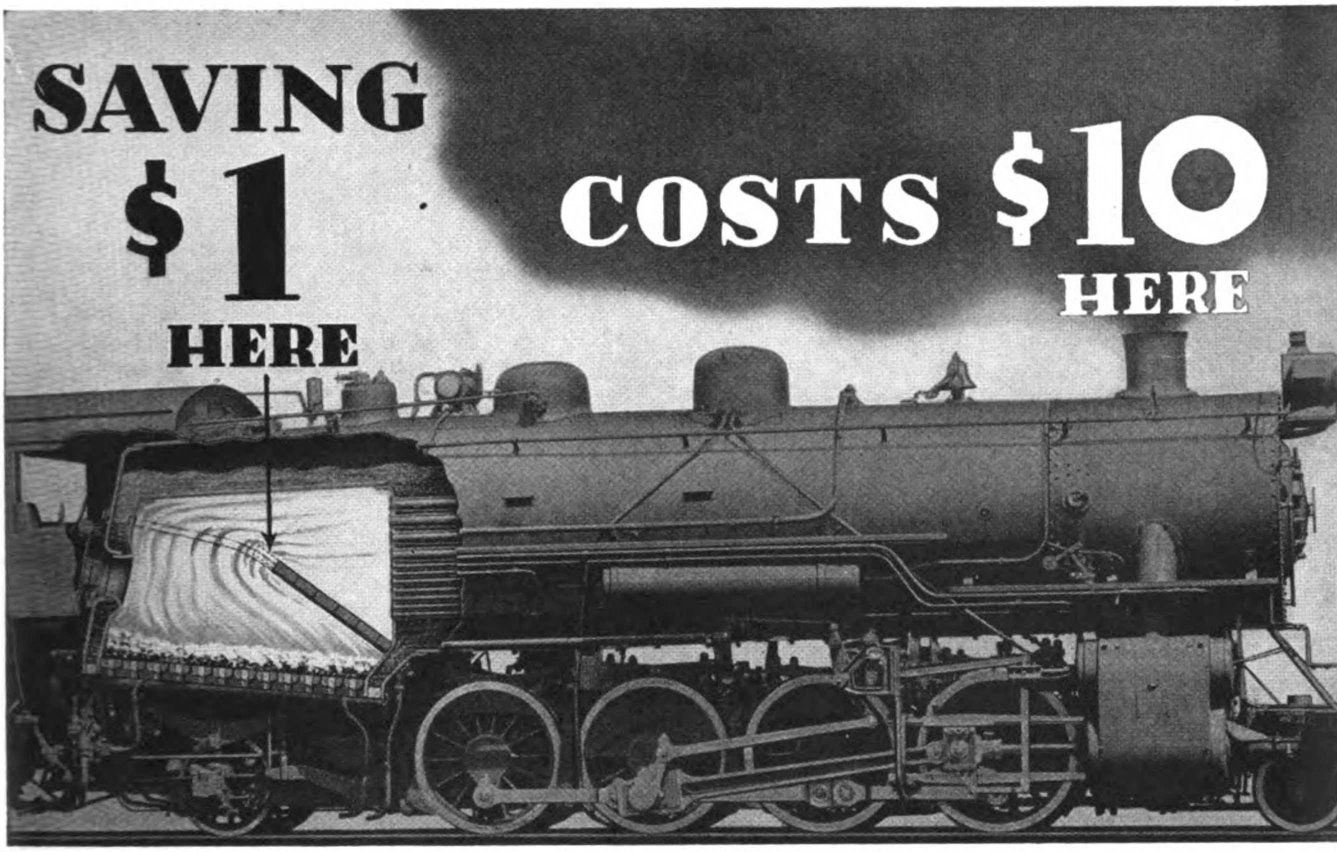


First rack-rail Diesel-electric locomotive built for Manitou & Pikes Peak



cut down on the arch and you boost the fuel bill

No one questions locomotive Arch economy. The Arch has been so thoroughly proved as a fuel saver by railroad after railroad for years past.

In the urge for money saving don't let the desire to save a few dollars in Arch brick expense by skimping on the Arch blind you to the fact that every dollar thus "saved", boosts the fuel bill ten dollars.

The surest way to the lowest operating cost is not in crippling proved economy devices but in making full use of them. This means complete Arches, with every brick in place, for each locomotive that leaves the roundhouse.

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.

Locomotive Combustion Specialists

tion of 14,109 ft., the engines rate about 100 hp. On the downward trip the locomotive simply backs down the grade in front of the passenger car. Dynamic braking assists in holding the car at a safe speed in descending the steep slopes.

Eddy Reappointed to Railroad Retirement Board

The Senate on August 1 confirmed President Roosevelt's reappointment of Lee M. Eddy for a Railroad Retirement Board term of five years from August 29. Mr. Eddy, whose nomination went to the Senate on July 28, is railroad labor's representative on the Board.

Enginehouse Stalls Extended at Laurel, Mont.

The Northern Pacific has awarded a contract amounting to approximately $16,000 to the J. C. Boespflug Construction Company, Miles City, Mont., for the extension of four stalls in its enginehouse at Laurel, Mont., to accommodate its new Z-5 and Z-6 freight locomotives (4-6-6-4 type) and the A-3 passenger locomotives (4-8-4).

President Approves Liability Act Amendments

President Roosevelt has signed S.1708 which amends the law relating to the liability of railroads for injuries to their employees along lines favored by railroad labor. The measure was finally enacted on August 4 with the adoption of a conference report reconciling differing House and Senate versions.

Among other things the amendments provide that in actions brought under the Employers' Liability Act, the so-called "assumption - of - risk - of - employment" defense will not be available to the carrier where an employee's injury or death results in whole or in part from the negligence of the carrier. Another provision makes it a criminal offense to coerce, discipline or discharge an employee in an effort to prevent or punish him for voluntarily furnishing information to a person in interest with reference to the facts incident to the death or injury of any railroad employee; the foregoing with the proviso that nothing in it shall be construed "to void any contract, rule, or regulation with respect to any information contained in the files of the carrier, or other privileged or confidential reports." The amendments also undertake to broaden the scope of the Liability Act so as to include within its provisions employees of common carriers who, while ordinarily engaged in the transportation of interstate commerce, may be, at the time of the injury, temporarily divorced therefrom and engaged in intrastate operations.

New Record in Average Freight Train Speeds

Railroads of the United States in the first six months of 1939 established a new high record in the average speed of freight trains, according to J. J. Pelley, president of the Association of American Railroads. This average speed, according to reports for the first half of the year which have just become available, was 64.1 per cent higher than the corresponding period in 1920.

In the first six months of 1939, the average distance traveled per train per day was 405 miles, compared with 400 miles in 1938 and 247 miles in 1920. This represents the average time required for the movement of all freight trains between terminals, including all delays en route.

Supply Trade Notes

The United States Rubber Company has moved its Detroit, Mich., sales branch from East Jefferson avenue to 5850 Cass avenue.

◆

John G. Munson has been elected vice-president, raw materials, of the United States Steel Corporation of Delaware, succeeding Thomas Moses, who retired on August 18.

◆

The Crane Company, Chicago, has been appointed national distributors of spring joints manufactured by the Chiksan Tool Company, Fullerton, Cal. The latter company will continue to maintain sales representatives in principal cities.

◆

The Inland Steel Company, Chicago, has issued licenses for the manufacture of Ledloy to the Heppenstall Company, Pittsburgh, Pa., and the American Rolling Mill Company, Middleton, Ohio.

◆

Kenneth J. Burns, district sales manager of the Youngstown Sheet & Tube Company, Youngstown, Ohio, has been appointed district sales manager of the Inland Steel Company, with headquarters in the company's newly opened district sales office at Cincinnati, Ohio.

◆

Alfred E. Munch, district manager of The United States Metallic Packing Company, Philadelphia, Pa., at St. Paul, Minn., has retired. He will continue his connection with the company in research work. Mr. Munch became associated with the company in 1927.

◆

Philip M. Guba, manager of sales, Chicago district sales office of the Carnegie-Illinois Steel Corporation since January, 1938, has been appointed eastern sales manager, with headquarters at New York and Pittsburgh, Pa. Specifically, Mr. Guba will co-ordinate sales activities of the company in the eastern area, including offices at Boston, Mass., Hartford, Conn., New York, Philadelphia, Pa., Baltimore, Md., and Washington, D. C. He will be succeeded at Chicago by G. A. Price, present manager of sales, bar, strip, and semi-finished materials division, general sales department, who in turn will be succeeded by T. J. Bray, Jr., manager of sales Pittsburgh district. J. G. Armstrong, Jr., assistant manager of sales, Pittsburgh district, will succeed Mr. Bray.

Philip M. Guba

Mr. Guba has been connected with sales in the steel industry since 1910. From 1918 to 1933, he was sales official of the Donner Steel Company and later of the Republic Steel Corporation. His association with Carnegie-Illinois began in March, 1933, as assistant manager of sales at the Detroit, Mich., office, becoming manager of sales at that office in March, 1935.

◆

Lester M. Curtiss, assistant general superintendent of the Lukens Steel Company, Coatesville, Pa., has been appointed general superintendent in charge of all operations of the company, succeeding G. Donald Spackman, who has been granted a leave of absence.

◆

Richard C. Poucher has been appointed to take charge of sales engineering problems for the Research Products Corporation, Air Filter division, in Ohio, Michigan, Pennsylvania and New York. Mr. Poucher was formerly with the Diamond Iron Works, Inc.

◆

G. R. Prout, acting manager of the southwestern district for the General Electric Company's industrial department, has been appointed manager of sales of industrial control, and W. T. Darcy, assistant to W. C. Yates, manager of the control and renewal parts division of General Electric's industrial department, has been appointed manager of sales of renewal parts. Both Mr. Prout and Mr. Darcy are located at Schenectady, N. Y.

◆

Raymond Willey, president of the Harbison-Walker Refractories Company, has been elected a member of the board of di-

rectors of the American Arch Company to fill the vacancy caused by the death of J. E. Lewis, former president of the Harbison-Walker Refractories Company. George A. Price, executive vice-president of the American Arch Company, has been elected to the executive committee in the place of Mr. Lewis.

◆

H. V. Huleguard, sales manager, Diesel locomotive division of the Baldwin Locomotive Works, has been appointed general manager of The Whitcomb Locomotive Company, Rochelle, Ill., a subsidiary of the Baldwin Works, the sales and engineering activities of the Whitcomb company formerly concentrated at Philadelphia having been transferred to Rochelle. Mr. Huleguard was general sales manager of the Whitcomb company previous to his becoming sales manager of the Diesel locomotive division of Baldwin.

Obituary

William H. Mussey, engineer of research of the Pullman Standard Car Manufacturing Company, Chicago, died in that city on August 22 of a complication of ailments.

◆

Benjamin Wilson, since 1918 assistant to the vice-president in charge of operations, of the American Car & Foundry Co., at New York, died in the Post Graduate hospital on August 16, after a brief illness, at the age of 58.

◆

Joseph Leidenger who retired as vice-president of the Dayton Manufactuuring Company in 1930, and for 20 years was New York representative of the company, died on August 11 at the New York Hospital after a long illness. Mr. Leidenger was 80 years old at the time of his death.

◆

Col. Anson Lee Bolte, who with William Waugh, founded the Waugh Equipment Company in 1908, died on July 24 in the Walter Reed Hospital in Washington, D. C., at the age of 79 years. Mr. Bolte served as vice-president of the Waugh Equipment Company until the company was sold to A. J. Pizzini and headquarters moved from Chicago to New York.

◆

William C. Whitcomb, who retired as president of the Whitcomb Locomotive Company, Rochelle, Ill., in 1933, died at Eagle River, Wis., on August 6. Mr. Whitcomb was born in Pittsburgh, Pa., in 1868, and upon completing a college training in engineering, joined his father in the operation of the George D. Whitcomb Company, which later became the Whitcomb Locomotive Company.

◆

Charles E. Robinson, whose death was noted on page 343 of the August issue, was born 62 years ago. He was a graduate of the Williamson trade school and a teacher of mechanical drawing there for one year before entering the employ of The Baldwin Locomotive Works. During his 40 years with Baldwin Mr. Robinson held many positions in the engineering department. For many years he had charge of the work of getting out sets of tracings furnished to the railroads with locomotive orders. He acted as a checker passing on the correctness of drawings and for some time was engaged in following up material ordered on the shops. At the time of his death he was manager of the engineering department.

C. E. Robinson

◆

Carl Mosier, vice-president of the Union Asbestos & Rubber Company, Chicago, died in that city on July 17 following a heart attack. Mr. Mosier was born in Oshkosh, Wis., on April 18, 1888. After completing a business course, he entered the employ of the Harriman Lines in the maintenance and operation department, where he served in a clerical capacity from 1906 to 1911. In the latter year, he became secretary to the chairman of the Board of the Southern Pacific, with headquarters at New York, and in 1912, became secretary to the president of the Illinois Central. He was later secretary to the president of the Chicago & Alton. Still later he was appointed assistant purchasing agent of the Chicago & Alton, which position he held until 1915, when he resigned to become associated with L. L. Cohen in the formation of the Union Asbestos & Rubber Company, as secretary-treasurer. In 1929, he was elected vice-president.

Carl Mosier

James Shields Thompson, chairman of the board of the Waugh Equipment Company, New York, died on August 23 at his home in New York. Mr. Thompson was born at Crestline, Ohio, on May 21, 1873. After finishing his education at the Bucyrus, Ohio, high school, he left home to engage in railroading. He began as a maintenance-of-way employee and progressed from one position to another, including that of locomotive engineman, until he became a mechanical engineer. During this time he worked for several railroads and served in the Spanish American War. In 1901 he became associated with the Sargent Company which merged with the American Brake Shoe Company in 1902 to form the American Brake Shoe & Foundry Company. Mr. Thompson, in 1911, was elected a vice-president of the American Brake Shoe & Foundry Company and in 1921 was elected to the board of directors of that company. In 1927 he became vice-chairman of the board and, when he resigned from the American Brake Shoe & Foundry Company in 1929, he was also senior vice-president, as well as a member of the executive committee. During his association with the American Brake Shoe & Foundry Company, he was actively engaged in perfecting and developing many important railroad devices as well as a new composition for use in automobile and truck brake linings. During this period Mr. Thompson was also an officer and director of the American Brake Materials Corporation, the American Forge Company, the American Plant and Building Company, the American Malleables Company, the American Manganese Steel Company, the Eastern Steel Castings Company, the Ramapo Ajax Corporation, the Southern Foundry & Machine Company, and the Southern Wheel Company. He gave up his active duties in the American Brake Shoe & Foundry Company in 1929 to found the Firebar Corporation, although he retained his position as vice-chairman of the board of directors of the former company until 1930 when he resigned in order to devote his full time to the Firebar Corporation at Cleveland, Ohio. In 1932 the Firebar Corporation merged with the Waugh Equipment Company, of which Mr. Thompson became chairman of the board of directors.

J. S. Thompson

(*Turn to next left-hand page*)

DIESELIZED YARDS AND TERMINALS HANDLE CAR[S]
MORE ECONOMICALLY AND WITH FEWE[R] ASSIGNED LOCOMOTIVES

50 to 75 per cent reduction in locomotive operating costs—high starting tractive effort plus quick acceleration—superior flexibility—high availability—are reasons why EMC "Clear-View" type switchers with unobscured visibility assure faster, smoother and safer car movements at lower cost and with fewer assigned locomotives.

With proved availability averaging 94 per cent, these money-saving EMC Diesels are delivering more work per dollar of invested capital and per dollar of operating expense. Greatest economies are derived from fully EMC Dieselized yards and terminals and where Diesels can be worked 24 hours daily. On one road alone 37 Diesels have replaced 80 steam switchers—and that means huge savings.

ELECTRO-MOTIVE CORPORATION

SUBSIDIARY OF GENERAL MOTORS LA GRANGE, ILLINOIS, U. S. A.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DIESEL OPERATION
Transportation at a Profit
Ruggedness for long life.
Stamina for long continuous running.
Power for heavy movements.
High Availability for intensive utilization.
Superior Visibility for safer, faster operation.
Reliability for low maintenance.
High Efficiency for low fuel consumption.
Accessibility for quick inspections.
Quick Acceleration for faster switching.
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GENERAL MOTORS
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POWER

Personal Mention

General

Edred B. Hall, general superintendent of motive power and machinery of the Chicago & North Western, has been appointed chief mechanical officer, with jurisdiction over all locomotive and car matters, with headquarters as before at Chicago.

Harry P. Allstrand, principal assistant superintendent of motive power and machinery of the Chicago & North Western, has been appointed assistant to the chief executive officer, a newly created position, with headquarters as before at Chicago. Mr. Allstrand was born at Council Bluffs, Iowa, on September 8, 1885, and graduated from Iowa State College in 1913. He entered railway service in 1903 as a machinist apprentice on the North Western at Missouri Valley, Iowa, and in 1907 was promoted to machinist and later to foreman at that point. In 1909, he left railway service to attend college at Ames, Iowa, returning to the North Western after graduation in 1913, as an enginehouse foreman at Clinton, Iowa, later being transferred to South Pekin, Ill., Proviso, Ill., and East Clinton, Iowa. Mr. Allstrand became division foreman at Chaldron, Neb., in 1918, and in 1919, was promoted to assistant master mechanic at that point. He later served as master mechanic at Eagle Grove, Iowa, Belle Plaine and Boone. In 1924, he was appointed efficiency supervisor, with headquarters at Chicago, and in 1926, he became assistant superintendent of motive power and machinery, with the same headquarters. Mr. Allstrand was appointed principal assistant superintendent of motive power and machinery in 1929. He was president of the Western Railway Club in 1929-30.

Harry P. Allstrand

A. G. Gebhard, master mechanic of the Illinois Central at McComb, Miss., has been appointed trainmaster at Jackson, Miss., with jurisdiction over the Gulf & Ship Island (part of the Illinois Central system), succeeding to a portion of the duties of L. F. Powell, who continues as trainmaster at Jackson, with jurisdiction over the Canton district from Jackson to Canton, Miss., and the Yazoo district.

W. H. Marlin, district road foreman of engines on the Southern Pacific at Los Angeles, Cal., has been promoted to assistant superintendent on the Salt Lake division, with headquarters at Sparks, Nev.

Master Mechanics and Road Foremen

A. K. Love has been appointed master mechanic of the St. Louis & Hannibal, with headquarters at Hannibal, Mo., succeeding A. E. Brand, who has retired after 49 years railroad service.

C. E. Bloom, general foreman on the Chicago, Burlington & Quincy at Lincoln, Neb., has been promoted to master mechanic at Casper, Wyo., succeeding E. A. Schrank, deceased.

H. D. Eddy, division foreman of the Atchison, Topeka & Santa Fe, at Bakersfield, Cal., has been appointed master mechanic of the Pecos division, with headquarters at Clovis, N. M.

W. D. Hitchcock has retired as master mechanic of the Albuquerque division of the Atchison, Topeka & Santa Fe at Winslow, Ariz. Mr. Hitchcock was born in Woolwich, England on July 30, 1869, and came to this country with his parents when three years old. He began his railroad career in 1888, and in February, 1890, entered the employ of the Santa Fe as a machinist at Raton, N. M. He served in this capacity at Needles, Cal., Albuquerque, N. M., and San Marcial, N. M. In November, 1902, he was appointed to enginehouse foreman at Raton, and in 1917, master mechanic at Winslow.

Albert D. Haley, who has been appointed master mechanic of the Illinois Central at McComb, Miss., as noted in the August issue, was born on October 23, 1894, in Claiborne County, Miss. He attended McComb City schools from September 1, 1899, to June 1, 1912, and entered the service of the Illinois Central on August 23, 1912, as a machinist apprentice at McComb. He became a machinist on August 1, 1916, and tool foreman on April 1, 1917. From July 25, 1917, to August 11, 1919, he was a machinist's mate, first class, U. S. Navy. He returned to the Illinois Central as assistant machine foreman at McComb on August 11, 1919. On November 1, 1919, he was appointed tool foreman; on March 1, 1921, assistant erecting foreman; on July 5, 1924, enginehouse foreman, and on September 1, 1927, general foreman. Mr. Haley was transferred to Markham, Ill., as assistant master mechanic on January 16, 1938, and on July 15 of this year (1939) returned to McComb as master mechanic.

A. D. Haley

P. J. Danneberg, master mechanic of the Pecos division of the Atchison, Topeka & Santa Fe, with headquarters at Clovis, N. M., has been transferred to Winslow, Ariz., to succeed W. D. Hitchcock.

Car Department

Walter E. Dunham, general superintendent of the car department of the Chicago & North Western at Chicago, has been appointed superintendent of the car department, with the same headquarters.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Drills. — Whitman & Barnes, Detroit, Mich. Catalog No. 96—drills, reamers, screw extractors, counterbores, interchangeable punches, etc.

◆

Sheet-Metal Working Machinery.— Ward Machinery Company, 564 W. Washington Boulevard, Chicago. Catalog No. 39. A reference book illustrating and describing machines, tools and supplies of nationally known manufacturers for fabricating sheet metals.

◆

Amsco Manganese Steel.—American Manganese Steel Division of the American Brake Shoe & Foundry Company, Chicago Heights, Ill. Sixty-four page illustrated booklet discussing properties of manganese steel and its use in equipment parts exposed to abrasive wear and impact. Amsco production and research facilities also described.

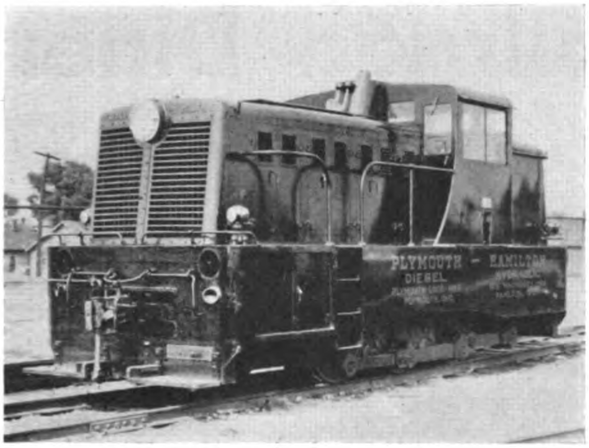
◆

Machine Tools. — National Machine Tool Builders' Association. Thirty-two page booklet, "Machine Tools and You,"— a reprint of an address given to the Army Industrial College at Washington, D. C., by Howard W. Dunbar, past president of the association and vice-president and general manager of the Grinding Machinery Division of the Norton Company.

RAILWAY MECHANICAL ENGINEER

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office.



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October, 1939

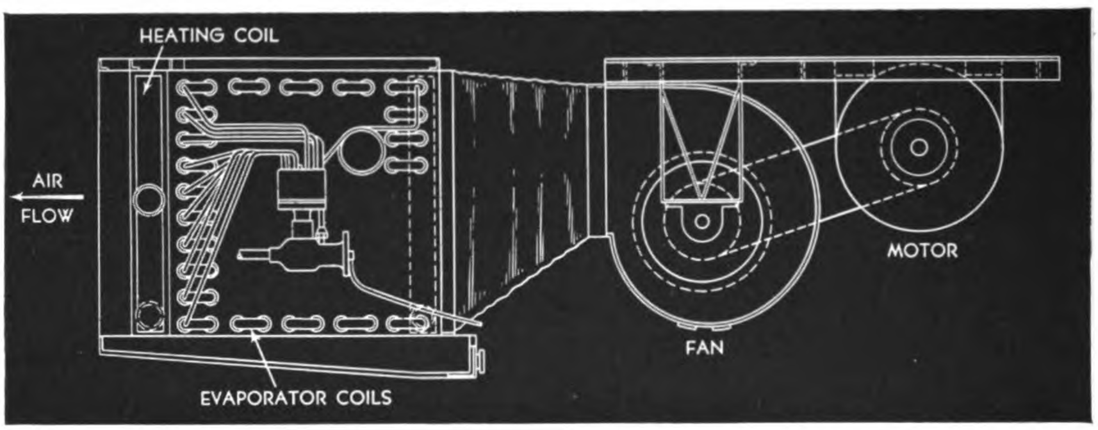
Volume 113 — *No. 10*

For 5 New Pennsylvania Railroad Diners

BUILT BY AMERICAN CAR & FOUNDRY COMPANY

☆

Sturtevant Fan and Coil Assemblies For Air Conditioning Systems



Side elevation of Sturtevant Fan and Coil Assembly used in connection with General Electric Air Conditioning Systems in five new P.R.R. Diners built by American Car & Foundry Company.

FOR the five new Pennsylvania Railroad Diners, recently built by American Car & Foundry Company—and embodying an entirely new level of luxury, beauty, and comfort—Sturtevant Air Conditioning Equipment was selected for low-side service. As illustrated, this equipment in each car consists of a complete fan and coil assembly, including main distributing fans with motor drive, direct expansion evaporator coils (Freon), and heating coils.

These Sturtevant Fan and Coil Assemblies were specially designed to very exacting Pennsylvania Railroad specifications—and to fit very limited space conditions.

Also selected for installation in these diners were Sturtevant Kitchen Exhaust Fans.

Sturtevant Air Conditioning Equipment For Every Purpose

Including equipment ranging from complete air conditioning systems (ice or electro-mechanical compressor) to individual units of equipment such as fans, evaporators, condensers, heating surface, etc.

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RAIL Sturtevant VANE
TRADE MARK
UNITS OR SYSTEMS

Sturtevant "Railvane" Units or Systems are used by 37 railroads. "Railvane" Air Conditioning is protected by 40 issued patents and other patents pending.

FOR 29 YEARS . . . PIONEERS IN AIR CONDITIONING

RAILWAY MECHANICAL ENGINEER

The Plymouth-Hamilton hydraulic-drive Diesel switching locomotive

High Performance With

Diesel-Hydraulic Locomotive

The 70-ton locomotive starts, accelerates, stops, holds and restarts a 300-ton load on a 5 per cent grade through hydraulic torque converter which permits full engine horsepower to be utilized at all speeds

A DIESEL engine made by the Hoovens, Owens, Rentschler division of the General Machinery Corporation and a hydraulic torque converter type of transmission for railway motive power use, developed by the Hydro Transmission Corporation, Hamilton, Ohio, are being demonstrated in a 70-ton six-wheel switching locomotive built by the Plymouth Locomotive Works, Plymouth, Ohio. The locomotive, an outline of which is shown in the drawing, has essentially the standard chassis of the builder. It has a wheelbase of 8 ft. 8 in. and a length over the couplers of 27 ft. 6 in.

The Engine

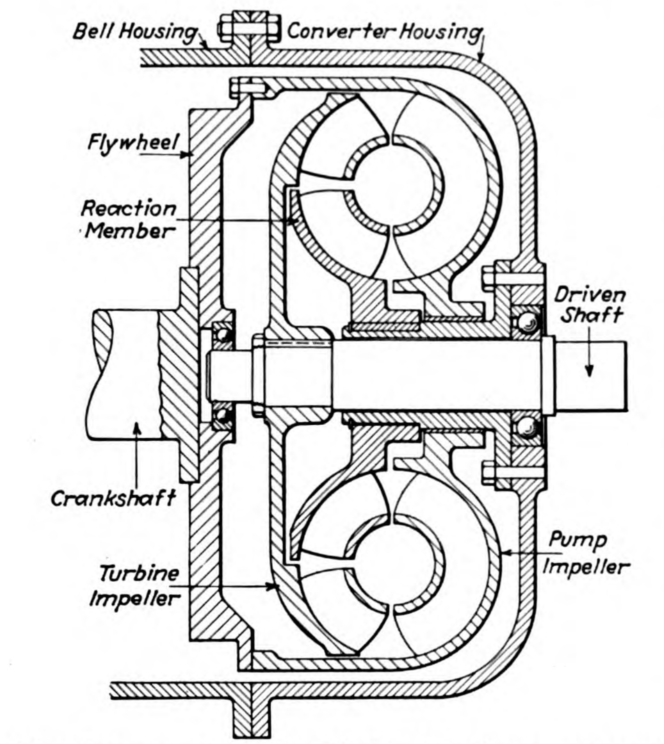
The six-cylinder Hamilton-M. A. N. Diesel engine has cylinders 8¾ in. by 12 in. and is rated at 400 brake horsepower at a crankshaft speed of 900 r.p.m. It is the four-cycle type, single-acting, with a solid-injection system and has two exhaust and two intake valves.

The cylinder block, cast in one piece, and the individual cylinder heads are of Meehanite iron. The cylinder liners of special cast iron are set in the cylinders and the cooling water circulates in the space between the liners and the cylinders. The cylinder heads are made in one piece with division walls and ribs to assure effective cooling. The cylinder head is bolted to the cylinder jacket by a number of studs of special steel. The joint between the cylinder and the cylinder head is dry.

In each of the cylinder heads is placed one fuel valve, one relief valve, two air-inlet valves, and two exhaust valves. The fuel is delivered to the injection valves by individual Bosch pumps operated from the main camshaft. The amount of fuel injected into the cylinder is controlled by the injection pump which is regulated by the governor. The fuel-valve nozzle injects the fuel into a water-cooled pre-combustion chamber and the injection pressure is determined by a spring-loaded valve in the fuel valve. The relief valves are set to protect the cylinders against excessive pressures. The air inlet and

exhaust valves are operated through push rods by the camshaft and are of a size to permit proper scavenging and charging of the cylinder with clean air.

The cast-alloy crankshaft has 7½-in. journals and 6¼-in. crankpins. The shaft is machined to a close tolerance to keep the bearings at right angles to the line of the piston at any point of the stroke. The crankshaft is drilled for the distribution of oil to the crankpin bearings. It is held in a longitudinal direction by one thrust bearing. The main bearings are of the precision type and require no fitting.



Schematic cross section of the Schneider hydraulic torque converter

The two-piece connecting rod is made of an open-hearth steel forging. The upper end of the rod is fitted with bronze bushings to carry the piston pin and the rod is drilled through the center for the pressure lubrication of these pins. The heat-treated, aluminum-alloy piston is fitted with five power rings and three scraper rings. The floating piston pin is carried in the cross bore of the piston which is plugged to keep lubricating oil from the pin off the cylinder walls.

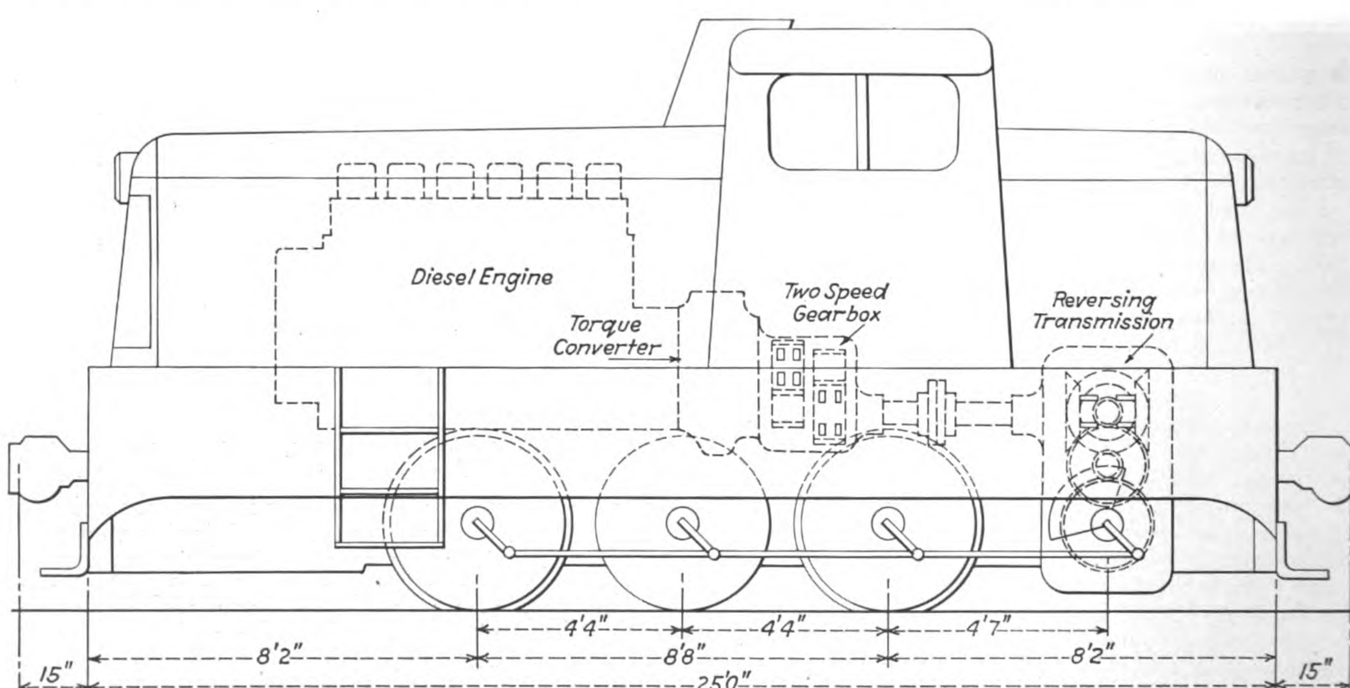
A centrifugal variable-speed governor is driven by bevel gears from the camshaft. The governor acts through linkage on the injection pumps and is controlled by the throttle. An over-speed device acts independently on the fuel-pump control rods and shuts off the fuel when the maximum speed is exceeded. The governor has an attachment which reduces the engine speed to idling upon the failure of the lubrication oil or the cooling water. A cooling system, comprising a fan, radiator, oil coolers and pumps, is furnished for the cooling of the water, lubrication oil, and torque-converter oil.

The Hydraulic Torque Converter

The Schneider hydraulic torque converter, a schematic cross section of which is shown in one of the drawings, consists essentially of three parts: (1) the centrifugal pump impeller attached to and driven by the Diesel engine flywheel; (2) the turbine attached to the drive shaft of the locomotive and, (3) the torque-increase feature, i.e., reaction vanes, which do not rotate and are attached to the converter housing. The housing of the converter is bolted to the engine housing. There is about ⅛-in. clearance between the rotating and stationary parts. The rotating parts are mounted on ball bearings and are lubricated by the converter oil. The power transmission through the converter varies with the engine speed and depends on the velocity of the oil through the various bladings in the converter.

The oil for the converter and the gearbox is carried in a tank located directly beneath them. The oil is pumped from the tank through a filter to the converter by a pump which is driven by V-belts from the forward

(*Continued on page 395*)



Outline and dimensions of the Plymouth-Hamilton Diesel switching locomotive showing the general location of the various parts of the power plant and the transmission

Trends in

Passenger-Car-Truck Design

A study of European and American data indicates the fundamental principle underlying good riding qualities

By A. Giesl-Gieslingen*

THE importance of providing better riding qualities for passenger and freight cars is generally recognized, today. In a recent article[1] K. F. Nystrom expressed the belief that providing a truck with satisfactory riding qualities without, at the same time, running into excessive weight, is probably the most important engineering problem confronting railroads and car builders. Since the problem has found the same intense attention in European countries as in the United States, a review of present trends and recent experiences is justified even though there are indications that the whole matter is still very much in evolution.

Let us first consider certain basic influences: a primary question is whether a short or a long wheel base should be favored and what the contour of the wheels should be. We have recently learned that these two questions are closely related under certain conditions, and the contradicting experiences made in this respect by various investigators can now be regarded as fully explainable.

A few years ago, it had been found by the Chicago, North Shore & Milwaukee[2] as well as by the German State Railways that wheel treads being cylindrical or having a smaller taper than the usual 1 in 20 largely eliminated the rapid nosing movement of the trucks which resulted in often quite violent lateral oscillation of the car bodies at higher speeds; the improvement, which H. A. Otis demonstrated by a moving picture before the A. S. M. E. was striking and wheel treads with a taper of 1 in 40 found wide adoption. However, in order to retain the advantages thus gained in running qualities, treads had to be re-machined at shorter intervals than hitherto because, as wear developed in service in the form of a groove, a steeper taper reappeared on the flange side of the wheel and the nosing movements increased again in frequency and intensity. Thus, running qualities were a function of distance run since the last tire turning and the German State Railways, for instance, specified tire turnings for high-speed vehicles at intervals of approximately 30,000 miles which is quite unsatisfactory from an operating and cost standpoint. Simultaneously, a longer wheelbase was favored for four-wheel trucks because, with a given wheel taper, it reduced the frequency of the nosing movements. A 9-ft. wheelbase was adopted on recent Zephyr trains, while 10 and 12 ft. became standard on various European railroads.

However, the conclusions above outlined were completely upset when the further research work of the German State Railways showed that strict elimination of all play between the axle boxes and their guides in the truck frame, combined with strictly parallel position of the two axles in the truck, eliminated any tendency of nosing even with steep tire tapers and worn wheels. This immediately explains why certain investigators who happened to use trucks with a rigid cast-steel frame, accurately machined to close tolerances, found, as Mr. Nystrom did, that there was no improvement with nearly cylindrical wheel treads and no deterioration with worn wheels.

This result is of greatest importance for future car construction; among other things, instead of favoring trucks with a long wheelbase and with accordingly greater weight, we can limit ourselves to a wheelbase sufficiently long to prevent excessive tilting of the frame under the action of the brake forces. But the only way to make such a truck permanently satisfactory is to eliminate the conventional journal-box guides which are subject to rapid wear, and to replace them by means permanently securing the required perfect alignment of the truck axles. This will be discussed below later.

The second basic question is: How should the spring arrangement be chosen in order to reduce to a minimum the influences of track unevenness upon the motion of the car body. Development began with a single set of springs introduced somewhere between the journal box and the car body as in the standard U. S. freight-car truck and in the older type of European four-wheel car.

Attempts to improve the spring action have almost universally led to the introduction of a second set of springs in series and for higher requirements it has been found best to combine friction springs (such as elliptic or semi-elliptic) and frictionless coil springs. The prac-

* Assistant sales manager, Wiener Lokomotivfabrik A. G., Vienna.

[1] Designing New Passenger Cars by K. F. Nystrom, *Railway Age*, May 20, 1939, p. 862.

[2] North Shore Reduces Truck Nosing, by H. A. Otis, *Railway Age* for Sept. 7, 1935, p. 301.

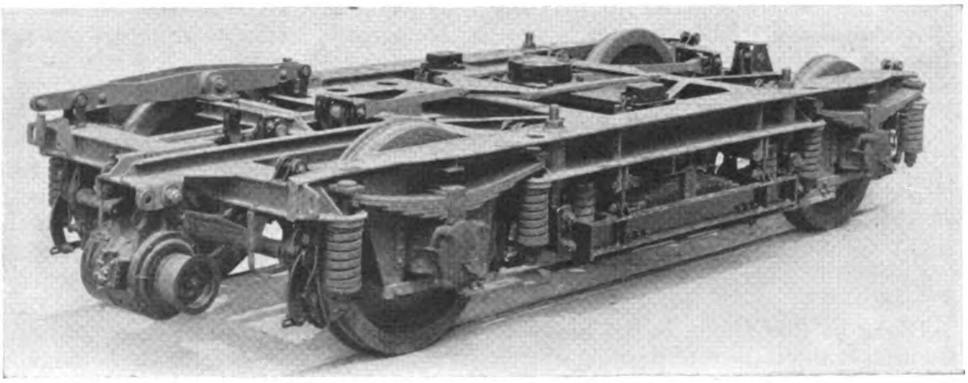


Fig. 1—Passenger-car truck with quadruple spring suspension

Fig. 2—A Mitropa dining car built in 1939. Length over buffers, 77 ft. 1¼ in.; weight in service order, 118,000 lb.

tical effect is that the coil springs respond to the slightest impact while the friction springs come into action with stronger impacts and simultaneously dampen the oscillations of the car body by virtue of their energy-consuming qualities. This system is used in the standard U. S. passenger truck as well as in most other countries.

To fulfill still more exacting requirements there has been a distinct tendency to arrange a still greater number of spring groups in series; thus the Pullman-Union Pacific truck uses triple spring suspension in combination with a double bolster. Triple suspension is also shown on Mr. Nystrom's experimental trucks and became standard in several European countries a good many years ago.

But the tendency of still further augmenting the number of springs has not stopped at the triple suspension. In England as well as in Germany, quadruple suspension has appeared and has been adopted as standard to a considerable extent. The truck shown in Fig. 1 gives an example of quadruple suspension wherein a combination of semi-elliptic and coil springs is interposed between journal boxes and truck frame as well as between truck frame and the bolster which carries the car body. The latest designs, as used under the 1939 Mitropa dining cars differ from the first merely by the introduction of softer coil springs for the bolster, characterized by the large diameter of 12 in. which is about double the diameter shown in Fig. 1.

The triple suspension, if well designed, has already given some remarkably good results, examples of which are given in Figs. 3 and 4 showing, respectively, horizontal and vertical motions of a car body at the vestibule end, on the City of Denver at 83 miles an hour and on a German Diesel train between Berlin and Leipzic at 99 miles an hour. In both cases, the track was in distinctly good shape; one might say, as good as it can ever be maintained under regular service conditions.

While the quadruple suspension can be made still less sensitive to track conditions, the question naturally arises whether there is any basic reason which would make a multiple suspension superior to the single combination of frictionless and friction springs in series. The answer is that the relatively heavy truck frame with all its accessories which we have interposed between wheels and car body and which in itself is nothing but an evil, furnishes the only justification for the use of multiple spring suspension. In recent lightweight cars the truck frame and attached parts weighed about 25 per cent of the car body load carried by the truck and this percentage has increased with modern light-weight construction because more weight has been saved in the car structure than in the truck.

As long as this frame is too heavy to be carried by the wheels without the interposition of considerable spring resiliency, the car body, in combination with the truck frame, forms a vibration system diagramatically shown in Fig. 5. Such a system has two frequencies at which resonance will occur, the impulses coming primarily from the rail joints. A numerical example was given by Karl Arnstein in his description of the Comet train in Mechanical Engineering for September, 1935, p. 556.

A study will show that we get very unpleasant resonance at high speeds if we provide a heavy truck frame with soft axle-box springs and that a danger of such high-speed resonance is minimized with harder axle-box springs and eliminated if we manage to provide a light truck frame supported upon the wheel with as little spring resiliency as possible. In fact, as far as the motion of the car body is concerned, the most favorable arrangement would be one that puts all the permissible spring resiliency between truck frame and the car body. This would also eliminate the several additional occasions for resonance which arise with the tilting and rolling motions of the truck frame.

One of the most practical steps toward improving the riding qualities of railroad cars is therefore the radical weight reduction of truck frame and attached parts. The realization that we may use a short wheel base under the conditions outlined above is an essential help in this direction.

The third basic question is: Should elliptic or semi-elliptic springs be retained or should they rather be replaced by coil springs combined with suitable damping devices. The combination of friction and coil springs has done very good service but the elliptic spring requires much space and, as a simple calculation will show, becomes much heavier for a given amount of energy absorption than the coil spring; from elementary spring formulae, the active volume of a coil spring is obtained as

$$V_c = W \frac{2G}{T^2}$$

wherein W is the total spring load times the deflection, G the modulus of rigidity, and T the maximum torsional stress without correction for spring curvature. For an elliptic spring or its equivalent stressed in bending, we obtain

$$V_e = W \frac{6E}{B^2}$$

wherein E the modulus of elasticity and B the maximum bending stress. Thus, the volume or weight of a coil spring compares with that of an elliptic spring of same strength and resiliency, as follow:

$$V_c = V_e \frac{1}{7.6}\left(\frac{B}{T}\right)^2$$

In general, the nominal torsional stress may be chosen

at least 60 per cent of the bending stress, so that the coil spring will weigh less than 40 per cent of the equivalent elliptic or semi-elliptic spring. In a well-sprung light-weight car, the substitution of coil springs may easily save more than 2,000 lb. and something additional because the entire design may be made more compact. Considering how important it is to reduce the dead weight of trucks, it requires no particular vision to see that the friction spring is bound to disappear from high-class passenger equipment and that we are going to introduce some sort of torsion springs with hydraulic damping.

Recent examples of high-speed passenger-truck construction show already at least partial realization of the above outlined principles. The French, for instance, have built, in 1937, an experimental passenger car with trucks working upon the principle of the American freight-car truck, and having such light frames of pressed and welded sheet metal that the introduction of springs between the truck frame and the wheels was

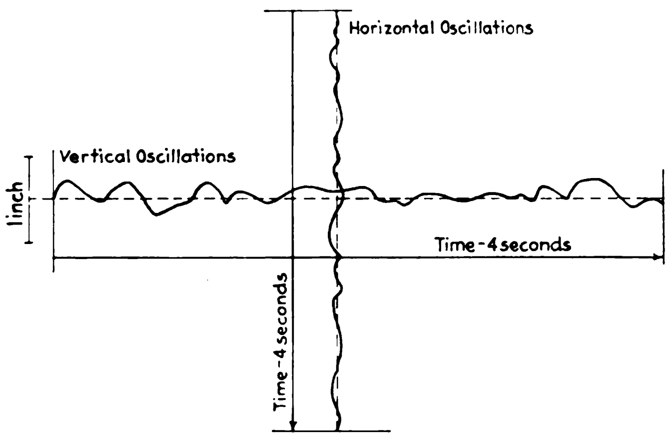


Fig. 3—Oscillating diagram of the City of Denver at 83 m.p.h. taken in the front vestibule of the first coach (non articulated)

considered unnecessary so that all the spring resiliency could be put between the frame and the car body.[3] The wheel base is only 8 ft. 2½ in. But in order to be unobjectionable, such a short wheel base should be combined with a rigid frame, which the American freight-car frame is not.

The German State Railways, which for seven years past had fully supported the older theory, favoring long wheel-base trucks up to 12 ft. together with very long soft semi-elliptic springs and triple and quadruple suspension, have now gone farthest in the introduction of the more advanced theories and the German standard truck which is going to be used for all passenger cars scheduled to be built in 1940 will have the following outstanding characteristics: The wheel base will be reduced to 7 ft. 0⅝ in.; swinging levers arranged parallel to the rails and attached to the roller-bearing journal boxes at one end and to the truck frame at the other, are going to secure perfect alignment of the axles. The journal-box guides merely act laterally. Tests have shown that this arrangement makes it possible to increase the running distance between tire turnings by 150 per cent namely, to 78,000 miles with no detrimental effect upon running qualities.

While the elliptic journal-box springs, arranged in series with coil springs are retained for the time being, the bolster is carried upon coil springs with hydraulic damping. The weight of the truck, without wheel sets and axle boxes, is only 3,950 lb., 42 per cent less than the lightest truck of earlier construction with a 10-ft. wheel base.

The new German streamlined passenger cars to be put into service from 1940 on will weigh only 62,000 lb. and will be 29 per cent lighter than those built in recent years. But the relative reduction in truck weight has been even greater and the truck frame including attached parts, weighs merely 16 per cent of the car body, thus going a

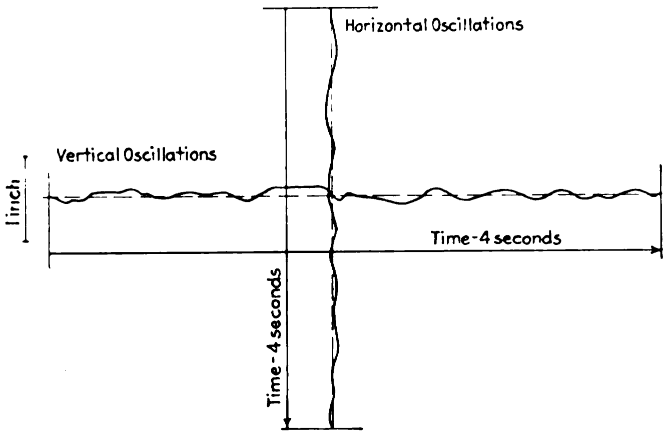


Fig. 4—Oscillating diagram of the Berlin-Leipsic four-car Diesel-electric train at 99 m.p.h. taken over the leading truck

long way toward realization of ideal conditions. These cars are to be about 77 ft. long between buffers, and are designed for a buffing load of 440,000 lb.

Further tests are being made in Germany with trucks which completely eliminate the conventional forms of springs and replace them by torsion rods in accordance with principles familiar to automobile and airplane designers. Another test is being made with conical wheel discs which permit reduction of bearing centers so that the truck width is sufficiently reduced to permit a streamlined enclosure to run unbroken from one end of the car to the other. Finally, an attempt is being made to do away with journal-box guides altogether, which can be

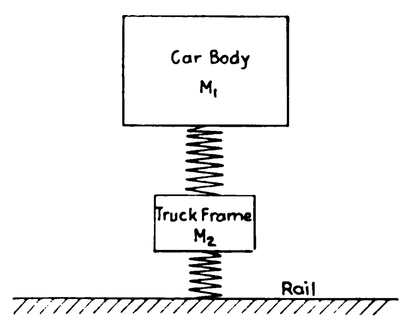


Fig. 5—Vibrating system of a standard passenger car

done by a suitable construction of the swinging levers used in the trucks of the 1940 model of the German State Railways to take care of the lateral forces, further approaching automotive practice.

In all these developments, the outboard journal has been retained, although the inboard type would permit further savings in frame weight. As long as journal-box springs of considerable resiliency are used, they have to be placed outside of the wheels in order to prevent excessive car-body roll. But, if none or but little springing is required between the axle and truck frame, the inboard arrangement is decidedly worthy of consideration if provision is made for sufficiently wide spacing of spring supports for the car body. This has already been done in the "Flying Silver Fish" which recently reached a speed of 145 miles an hour between Berlin and Hamburg.

[3] See Revue Générale de Chemins de Fer, February, 1937, p. 4.

F. B. Downey, President

Program is broad enough to interest administrators and supervisors in back shop and enginehouse, tool specialists, apprentice supervisors, and chief locomotive inspectors

New Association to Deal with

Locomotive Maintenance

THE program of the Locomotive Maintenance Officers' Association (International Railway General Foreman's Association) for this year's meeting, to be held at the Hotel Sherman, Chicago, October 17, 18, and 19, is concrete evidence of the work that has been done by its officers and members to direct the activities of the association toward future objectives which will broaden its usefulness, at the same time limiting its field to the problems involved in locomotive maintenance. From the time of the organization of the original General Foremen's Association until the depression, when its activities were of necessity temporarily suspended, the program of the association was so shaped as to interest supervisors of car repairs as well as those responsible for locomotive work in the backshop and the engine terminal. It became increasingly evident as time went on that the problems of the car department were more or less unrelated to those encountered in locomotive maintenance. As now organized, the Car Department Officers' Association serves the car-department administrator and supervisor as well as the interchange inspector.

Recognition of this fact has undoubtedly been a major factor in the decision of the present Locomotive Maintenance Officers' Association to limit the field of the new association to the problems involved in the maintenance of locomotives, both in the backshop and engine-house. The Fuel and Traveling Engineers' Association deals effectively with locomotive operation, but there is no other organization which is prepared to consider the problems of shop and enginehouse management or the multitude of questions pertaining to maintenance standards and the methods and practices of servicing and repairing locomotives.

The new association has received many definite assurances that the decision of its executive committee to broaden the scope of its work in this specific field will meet with the whole-hearted support of progressive mechanical officers. The progams of this year's meeting is broad enough to interest shop engineers, shop superintendents, enginehouse foremen, chief locomotive inspectors, supervisors of shop machinery and tools, apprentice supervisors, mechanical engineers, and their assistants. Because this year's meeting is one of unusual importance in the formation of association policies and the opportunity to establish the ground work of the association's activities for years to come, there should be a large attendance. The officers of the association have already envisioned the possibilities for definite and valuable committee work on subjects involved in shop and enginehouse operation which as yet have had no part or treatment in the program of other associations.

In considering the potential usefulness of this association, it may be well to keep in mind that more money is spent in the railroad industry for locomotive repairs than is spent for any other single item of operating expense. Whether or not this money will be spent wisely in the future will depend upon the intelligence and the breadth of knowledge of those who are responsible for spending it. The Locomotive Maintenance Officers' Association, as it is now being reorganized, will be one of the few effective agencies available for broadening the knowledge and sharpening the intelligence of these men.

What Is the

Car Officers' Association?

C. J. Nelson, President

Organized as a form for arriving at uniformity of interpretation of interchange rules, it has gradually broadened to present organization for the study of problems of car maintenance and operation

WHAT is the Car Department Officers' Association? What are its objectives? Does it merit general support? These are pertinent questions which deserve thoughtful answers.

The association was originally organized in 1901 under the name Chief Interchange Car Inspectors' and Car Foremen's Association, its activities being broadened in scope in 1926 and the name changed to Railway Car Department Officers' Association. In 1928, it united with the Southwest Master Car Builders' and Supervisors' Association and adopted this name except for the elimination of the word "Southwest." In accordance with the wishes of the A. A. R. Mechanical Division, the name of the association was again changed in 1930 to Car Department Officers' Association, a name which has been retained since that time.

Quoting the constitution: "The objects of this association shall be to bring together supervisors interested in car department matters, for the advancement of knowledge pertaining to safe and economical operation, and to exchange ideas, discuss problems, promote uniformity, effect economies in car construction, maintenance and operation; also to make constructive recommendations to the Association of American Railroads."

In considering how much general support this group of car supervisors merits, it should be remembered that Class I railroads spend annually somewhere in the neighborhood of $275,000,000 on car repairs. The efficiency with which this work is done and the money expended is dependent in the last analysis upon the competency and morale of car supervisors from department heads down. These men must be familiar with the best practices not only on their own, but on other roads, and it is difficult to see how they can acquire this familiarity if individual foremen and supervisors are held so tightly to their respective jobs that they seldom get an opportunity to visit other car repair points or attend gatherings of car men.

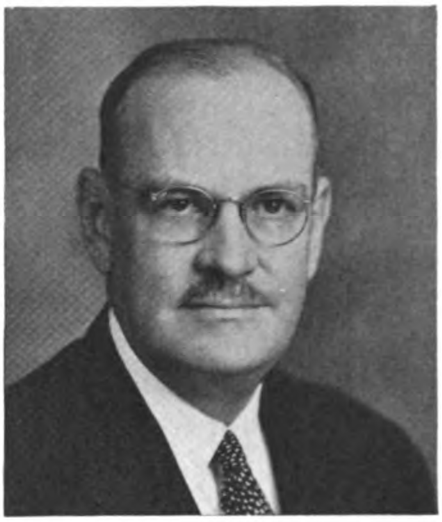
Unquestionably, therefore, it is very much in the interests of each railroad to send as many leading car men as practicable to the annual meetings of the Car Department Officers' Association. Constructive programs are provided. The relatively small expense entailed is insignificant when compared with the amount which may be saved as a result of giving car men an opportunity to get together once a year, compare notes, discuss mutual problems and disseminate information regarding the latest practices in car departments.

The possibilities and potential importance of the Car Department Officers' Association are emphasized in an editorial published on page 452 of the November, 1938, *Railway Mechanical Engineer,* which says in effect that, with the proper leadership and direction, the association may be developed not only to improve the knowledge, acquaintance and morale of car department supervisors but serve as a valuable adjunct to the A. A. R. Mechanical Division, in no way overlapping or duplicating the work of this important organization.

Apparently mechanical-department heads can take hardly a more constructive single action in the interests of increased economies in the car department and hence better railroading than to support whole-heartedly the Car Department Officers' Association. This means primarily to recognize the soundness of its objectives and help the attainment of these objectives by sending as many supervisors as practicable to the annual meetings.

Locomotive Operation Completely Covered by

Fuel and Traveling Engineers



J. R. Jackson, President

With the October meeting this association begins its third year as the amalgamation of the two strongest of the voluntary mechanical organizations—The association provides a single forum for the problems of locomotive service

THE Railway Fuel and Traveling Engineers' Association, as now organized, is a happy combination of two important groups of railroad men—namely fuel supervisors and representatives of locomotive service, primarily traveling engineers. The association membership also includes representatives of companies engaged in the production of fuel, either coal or oil, fuel-handling devices, locomotive fuel-saving accessories or anything which contributes to fuel economy and improved locomotive operation.

The organization of fuel men, formerly known as the International Railway Fuel Association, held its first annual meeting in Chicago in 1908 and was designed to concentrate the attention of railway officers on all phases of the problem of effecting economies in fuel consumption which, at that time, were particularly feasible and desirable. The association grew rapidly in size and importance and at one time had a membership of over 1,200. It adopted an aggressive and constructive policy of education in fuel saving methods which has been credited with much of the success of the railroads in reducing unit fuel consumption and cost figures.

In the ten-year period from 1920 to 1930, for example, the unit fuel consumption in pounds of coal per 1,000 gross ton-miles, not including the weight of the locomotive and tender, was reduced from 197 lb. to 138 lb., or 30 per cent. Similarly in passenger service, the pounds of coal per passenger train car mile dropped from 18.8 lb. to 14.7 lb. or 22 per cent. One reason for the effectiveness of this association of fuel men was the fact that it offered a common meeting ground for both railway and fuel supply company representatives, with the result that improved practices in the inspection and preparation of fuel were developed and generally applied.

In 1936, as the result of a demand for greater economy and less overlapping in the work of various railway associations, the International Railway Fuel Association was consolidated with the Traveling Engineers' Association under the name "Railway Fuel and Traveling Engineers' Association." The original T. E. A. was organized in 1893 and held 38 annual conventions up to and including the last meeting in Chicago, September, 1930. This association had a remarkable record of usefulness and at one time boasted a membership of over 1,600. It was devoted to all phases of improvement in locomotive service including fuel economy, however, and hence overlapped the work of the International Railway Fuel Association to a certain extent. The union of these two associations, therefore, in a single aggressive group was obviously in order and very much in the interests of the railroads as well as the two associations.

The Railway Fuel and Traveling Engineers' Association is now holding its third annual meeting this month at the Hotel Sherman, Chicago. A high point in the program this year, which will be enjoyed jointly by the members of the four associations meeting at the same time this year, is the opening address on training supervisors by L. W. Baldwin, president, Missouri Pacific. Air brake subjects will be presented on the afternoon of the first day, also possible fuel economies in power-plant operation. On the second day, devoted to mechanical design features, the following general subjects will be considered: New locomotive economy devices, maintenance, steam turbine locomotives, utilization of locomotives and firing practice. The third day, designated fuel day, is allotted for the consideration of such subjects as fuel wastes and losses, fuel records and statistics, preparation of washed and dried coals, etc.

This well-balanced program is typical of the Railway Fuel and Traveling Engineers' Association. It is typical of the comprehensive, well-edited and instructive year book put out by the association. It is typical of the service which this association endeavors with notable success to perform for individual members and, through them, to the railroads they represent.

The Boiler Makers' Association

W. N. Moore, President

An organization of demonstrated independence and resources continues to keep in vital touch with the problems of boiler maintenance and boiler-shop operation

THROUGHOUT its history the Master Boiler Makers' Association has enjoyed the respect and confidence of the managements of American railways to a high degree. Its programs have always been intensely practical and have wielded a wide influence in hastening the spread of knowledge concerning all developments affecting boiler-shop practice and boiler maintenance, as well as in crystallizing the formation of sound opinion in its committee reports and symposia on details of practice. It is not one of the largest mechanical-department associations, but the quality of its proceedings has built up a strong interest in the work of the association throughout its particular field of activity.

Two master boiler makers' associations of similar purpose but differing in the field covered were organized in 1902. These were the International Railway Master Boiler Makers' Association and the Master Steam Boiler Makers' Association. They came together by amalgamation in 1907 and reached a peak in membership of 631 in 1919 during the period of federal operation of railways in the United States. The work of the association continued successfully throughout the prosperous years following, but it was the depression which brought out the particular quality of independence possessed by this organization.

During the depression the Master Boiler Makers' Association suffered from the curtailment of meetings just as did all other organizations in the railroad field. Unlike most of the others, however, it did not accept its fate with resignation. When meetings were impossible, through the energy and ingenuity of its officers, the association organized two "conventions in print," the first being distributed in 1931 and the second in 1933.

Then followed a limited business meeting of the association in 1935, and a meeting in 1937 at which no restrictions were placed on attendance. At the time of the 1937 meeting the association had a membership of 152, an increase of 87 from the time of the limited meeting in 1935.

Again in 1938 the activities of the association were somewhat curtailed in that a business meeting was held instead of the usual full association convention. Considering the difficulties through which this association has passed since 1930, it was a real accomplishment to be able to announce the waiving of dues for the current year.

But it is not the history of an organization, no matter how excellent its record, which recommends it for the support of its own constituency and of railway managements generally; it is the quality of its work and the influence of its programs on the daily work of its members. The program of the meeting to be held this month at the Hotel Sherman, Chicago, carries its usual quota of intensely practical topics. One of these topics, which has been under consideration for several years, is pitting and corrosion of locomotive boilers and tenders. This year, as in the past several years, the study of the practical aspects of this problem are supplemented by a contribution from an expert in its scientific aspects.

The association is also showing its foresight with respect to its shop problems by scheduling a paper on apprenticeship. Its work this year justifies a continuance of the confidence in which the association has long been held.

Trends in the Development of

Machine Tools

As this is being written there are many evidences that the railroads of this country are facing the possibility of increases in traffic that may establish new carloading records. It is a foregone conclusion that with a rise in industrial activity the railroads will be called upon to provide that backbone of volume transportation which no other agency is as well equipped to furnish. The ability of the roads to meet this increasing demand will depend on two important factors, equipment and men.

It is the equipment situation which immediately comes into the limelight when prospects of increases in traffic appear and the problem of furnishing sufficient equipment is one that can be solved, in so far as the roads themselves are concerned, primarily by throwing into high gear the activities of repair shops and stepping up the output of repaired and rebuilt cars and locomotives. In those cases where insufficient equipment exists or where equipment is in such condition as to make its repair or rebuilding of questionable certainty from an economic standpoint, it is fortunate that the industries which serve the railroads are in excellent position to make up the immediate deficiencies.

No one will question the vital importance of the railroad repair shops in the present situation, and because they are such an important link it is in order to speculate upon the conditions that surround their ability to produce and the factors which can contribute to an increase in their efficiency. In this latter respect there is no part of their facilities which has such an important all-around bearing on the efficiency of output as modern machine tool equipment. This being the case it is only fair to assume that to outline the developments that have taken place in the machine tool field in recent years and the influence of these developments on that kind of work which railroad shops are called upon to perform will provide a basis upon which to determine whether or not the shops are now in the best of condition to meet the demands that are to be made upon them.

Contrary to many opinions the railroad shop, as regards machine tool equipment, depends, for the most part, on general purpose machines rather than those designed for special purposes. Except for large, heavy duty machines used especially for the purpose of turning the treads of car wheels and locomotive tires the entire machine tool equipment of the average railroad shop is made up of units that are designed to perform the basic metal-working functions of turning, boring, milling, planing and grinding. Moreover, because of the fact that railroad machine work is a problem of producing a variety of parts in relatively small quantities rather than the production of large quantities of identical parts, special machines and special equipment are necessarily limited in application. So, in considering the adaptation of the modern machine tool to this kind of work it is important to know what has taken place in the development of the engine lathe, turret lathe, boring mill and vertical turret lathe, milling machine, planer and grinder that will contribute to an increase in output on the kind of work that has to be done.

The designers and builders of machine tools, regardless of the type, have had as a common objective the production of a tool that would remove greater quantities of metal in a given amount of time with a resulting accuracy of finish held to closer tolerances than ever before. Increases in metal-removing capacity depend upon a tool steel that will stand up under heavy cuts and, this having been provided, certain inherent changes in machine design leading toward heavier construction and better power transmission systems. Therefore a decided trend has been that toward the use of better materials, such as heat treated alloy steels, in the construction of all machine parts and toward greater weight which after all is necessary to insure the rigidity which eliminates vibration, increases the life of cutting tools and promotes greater accuracy. Ground gears, high-speed shafts running in anti-friction bearings, moving parts flooded in oil and more generous supplies of coolant to cutting tools are accessory factors which contribute their part to increased capacity.

The physical ability of the machine to remove more metal in a given time is only part of the story. When all factors are considered, production in finished parts at the end of a day is dependent upon reducing the "floor-to-floor" time on each piece to an absolute minimum. The part under consideration may be one requiring only one cutting operation or it may require several operations. If it is a one-operation job then the important factor is the ability to take heavy cuts at high speed and finish the job to the required degree of accuracy and quality of finish without loss of time. It is in the multiple-operation jobs where the machine designer has really made great strides in the last few years. Where a few years ago the lathe, planer, boring mill or milling machine performed one operation at a time the machine of today has combined the advantages of multiple cuts and additional cutting heads to make it possible to do two or three steps in the finishing process in less time than the older machine took to perform one step. The ability to make multiple cuts has been brought about by the development of tooling equipment which is responsible for the great increase in the range and capacity of standard machines.

Controls Play Important Part

A large part of the ability of modern machine tools to remove greater quantities of metal in shorter periods of time is due to control mechanisms—both integral and accessory—that enable an operator to make changes in speeds and feeds, and to start and finish operations with a facility and precision that did not exist in the machine tool of a few years ago. The development in electrical controls has not only greatly simplified the problem of starting and stopping a machine but has permitted the application of many devices that add greatly to the speeding up of the machine while at the same time making it a safer machine to operate. The use of automatic electric limiting devices has gone a long way toward making the modern machine tool fool-proof.

Hydraulic drives and controls have contributed immeasurably to the increase in usefulness of certain types of machines. The hydraulic drive, with its stepless speed adjustment and uniform cutting pressure, make it possible to produce finer finished work on planers, slotters and shapers and the higher return ratio of this type drive contributes to a substantial reduction in machining time.

Wheel Shop Machinery

High train speeds in both passenger and freight service have had the effect of making obsolete the existing machine tools used for wheel work. The older ma-

chines are not capable of turning wheels to standards of accuracy that are now demanded. In addition to the demand for increases in production there is now a positive demand for closer tolerances which the older machines can not meet. In rolled-steel car wheel work present operating conditions require that wheels be perfectly round and smoothly finished. In addition it is considered by some roads desirable to balance wheels and this factor, plus the element of thorough inspection, has resulted in the development of special machines which the wheel manufacturer is using to finish the plates of rolled steel wheels.

It is the turning of wheel treads, however, that presents the real problem as far as the railroad shop is concerned and it is in car wheel turning machines that developments have taken place of major significance. The new machines are capable of taking heavier cuts at 40 to 50 per cent higher cutting speeds and new tooling methods have made it possible to produce a smooth, chatter-free surface at higher finish-cut speeds than are used in the roughing cuts. The new machines, too, are designed to permit the turning of wheel sets equipped with roller bearings without the necessity of removing the bearings from the axles. In summing up the advantages of the new designs in wheel turning machines it is said that the ability of the machine to turn out work is limited only by the tool steel.

In reviewing the development in the machine tool field and its influence on the railroad shop one or two facts stand out. Five years ago the average age of machine tools in the average well-equipped railroad shop was over 20 years. Five years have gone by during which the railroads have bought comparatively little in the way of modern shop tools. The major developments in machine tools have been introduced during the past five years. The machine tool inventory of the railroads today is made up of units that fall far short of being able to compete with the machines that are available today. It is upon these obsolete machines that a substantial part of today's repair dollar will be spent and it is obvious that part of it will be wasted. Only an intelligent program of shop equipment replacement will eliminate such waste from future operations. The tools with which to do it are available.

Diesel-Hydraulic Locomotive

(Continued from page 386)

end of the Diesel engine. The operation of the converter does not depend upon the pressure developed by this pump. Its function is to keep the converter filled with oil. The flow of oil through the converter will be less than 20 gal. per minute. Auxiliary equipment cools the converter oil.

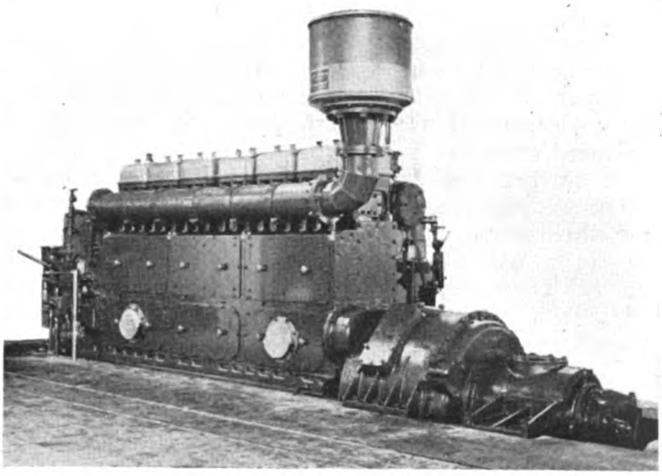
A selective two-speed gear box with a gear ratio of 1 to 2.5 is bolted directly to the housing of the torque converter. It has two identical and interchangeable gear sets with their positions reversed on the shafts so that two identical pinions and gears are always in mesh. The hydraulic clutch consists of plates with annular V-grooves which match a set of pistons carried in a drum attached to the shaft. The clutch plates form the hub of the gear.

To engage the clutch, pressure is applied to the pistons by oil supplied by a small high-pressure pump coupled to the torque-converter pump. To change from low to high gear, the shifting valve is moved by the operator from low to neutral to high positions. This relieves the pressure behind one set of pistons and applies pressure to the other set of pistons. It is not possible to engage both clutches at the same time as the oil supply to them passes through the shifting valve.

The locomotive with its load can be started in high or low gear without causing damage to the engine or the transmission due to the use of the hydraulic torque converter. As most of the slip during clutch engagement is taken up by the converter, the clutch wear is said to be very small and the clutches can be of the quick-gripping type. Road shocks are not transmitted to the engine, or engine shocks to the road bed, because there is no mechanical connection between the engine and the transmission.

The reversing transmission is rigidly held in position at the rear of the locomotive by wedges and bolts. It is of the compound type in order to obtain the necessary speed reductions with gears of proper dimensions. To obtain equivalent wearing properties and to divide the wear on both sides of the gear teeth, the first speed reduction is by two spiral bevel pinions with the drive shaft passing, with clearance, through their bores. This shaft carries an external-internal-tooth type of clutch which will engage either pinion to produce the forward and reverse motion of the locomotive. These pinions drive a large spiral bevel gear mounted on the hub of a herringbone pinion. This pinion drives a large herringbone gear mounted on the shaft of a second herringbone pinion which, in turn, drives the herringbone gear on the jackshaft.

The gears and shaft are accurately machined and mounted on roller bearings. An oil pump in the trans-



The 400-hp. Hamilton-M.A.N. Diesel engine with hydraulic torque converter and two-speed gearbox

mission supplies oil to the gears and bearings mounted in the upper part of the gear case and furnishes the oil pressure to operate the forward and reversing interlock. A self-aligning coupling of the external-internal-gear type connects the reversing transmission through the two-speed gearbox to the hydraulic driving unit.

The torque converter permits the constant horsepower of the Diesel engine for any given throttle setting to be converted into varying combinations of locomotive speed and driving-wheel torque automatically, depending upon the traction demand of the load on the locomotive. At a demonstration at the Willard, Ohio, yard of the Baltimore & Ohio during the summer the performance of the locomotive was shown by starting, accelerating, stalling, restarting and holding a load of 300 tons on a 5 per cent grade through the hydraulic transmission. Throughout the demonstration the engine continued to operate without overload, its load and speed under throttle control.

Power Reverse Gear Operating Valve

The new Type M-3 power reverse gear operating valve, now being extensively introduced by the Barco Manufacturing Company, Chicago, is said to have given satisfactory results in over 600,000 miles of high-speed passenger test service. The valve is designed to assure equal total pressure on each side of the piston, except when the point of cut-off is being changed, thereby eliminating the usual cause of creepage. The cut-off position selected is held accurately, even in the event of failure of the air supply due to a broken pipe or other cause. These results are obtained through the application of check valves, in the admission ports between the admission valve and each end of the cylinder. Air can be exhausted from the cylinder through separate exhaust ports only by opening the individual poppet exhaust valves.

The theory of the balanced power-reverse gear is that the greater total pressure on the rear of the piston, due to the piston rod on the front of the piston, forces the piston ahead until the pressure per square inch on the piston rod end builds up to a point where the total pressure balances the total pressure on the back of the piston. Actually, however, as soon as the pressure builds up in front of the piston beyond the reservoir pressure, the higher pressure goes back into the line and the unbalanced condition continues, causing the piston to fluctuate, or travel back and forth, continually.

With the check valves interposed, as in the Barco M-3 valve, the air in the cylinder cannot come back into the supply line through the admission ports, thereby allowing the pressure per square inch ahead of the piston to increase until the total pressure is the same on each side of the piston, providing an accurately balanced condition.

A further feature of the M-3 valve is that in the event of breakage of the air supply pipe or failure of air, the reverse gear maintains its position, as the air cannot get back out of the cylinder through the admission valve. The air can be removed from the cylinder only by moving the quadrant lever and opening one of the poppet exhaust valves.

The M-3 valve is equipped with a double air-supply inlet, with ball check provided, so that an auxiliary air supply pipe may be applied and used in the event that the regular air supply pipe breaks or fails. With this arrangement, locomotive failures from broken air supply pipes may be eliminated, as in the event of failure of the supply pipe, it is only necessary to plug the broken pipe and proceed with the air through the auxiliary pipe. As the air remains in the cylinder, the valve motion will maintain its position without damage.

The Barco Type M-3 dual control operating valve is applicable for use with all types of power reverse gears.

T-Z Brake Hanger Wear Blocks

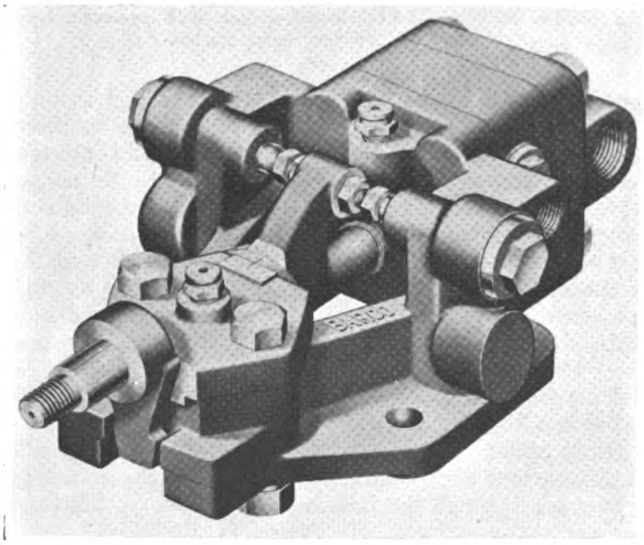
The T-Z Railway Equipment Company, Chicago, has recently brought out and placed on the market a pair of wear resisting blocks for use in connection with the brake beam hanger brackets of railway car trucks. The object of these wear blocks is to relieve the hanger brackets of direct wear by the link hangers supporting the brake beams.

These blocks are designed, as regards size and shape, to fit into the design of truck side bracket approved by the A. A. R. Committee on Brakes and Brake Equipment and to be secured within the recess of the bracket by the method recommended by that committee.

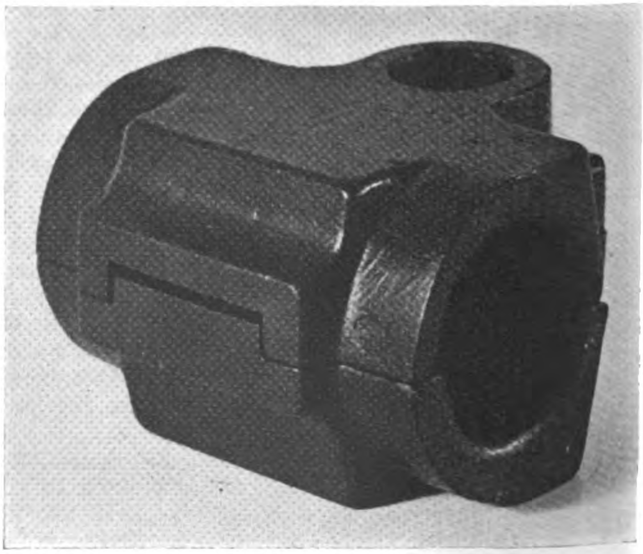
In order to give long service the blocks are made of cast steel and with strength sufficient to withstand the alternate stresses imposed by the link hangers in service. They may be readily removed from their recesses in the pockets of the hanger brackets which form an integral part of the truck side frame.

The blocks have large bearing surfaces to minimize the wear on the truck hanger brackets. The lower one has a full half circle bearing surface for the link hanger in order to decrease the tendency of both block and link hanger to wear. The upper one has clearance to permit oscillatory movement of the link hanger and to prevent binding of hangers and blocks, at the same time providing adequate resistance and strength against upper thrust during the operation of the brakes.

To keep the blocks in alignment they have a male and female joint arranged at right angles to the bearing surfaces for the link hangers and, as they bear against the semi-circular part of the bracket recesses and with the retaining bolt fully surrounded by both the blocks, movement in any direction is rigidly resisted.



Barco type M-3 power-reverse-gear operating valve with separate inlet and exhaust valves



Brake-hanger wear blocks developed by the T-Z Railway Equipment Company

EDITORIALS

Is the Repair Shop Equal to the Job?

Early in September, when freight car loadings were still over 100,000 cars below the present figure, the A. A. R. gave out a prediction that the railroads of this country could handle a 45 per cent increase in traffic by repairing approximately 200,000 freight cars and 8,000 locomotives then awaiting repair. In the short space of five weeks the loading figures have jumped to over 800,000 cars and seem to be headed for still higher levels. Reports are coming in from all parts of the country of repair shops being put on longer working hours and furloughed employees being recalled to the job.

Regardless of whether the traffic that the railroads will probably be asked to handle can be taken care of without difficulty or not there is one certain fact and that is that the car and locomotive repair shops of this country are going to be called on to deliver maximum output as long as the present emergency lasts, for it is upon the shop that the burden of producing today's motive power and rolling stock rests.

It is not strange that when the shops are shut down it is a rather difficult matter to get railroad management to give much serious consideration to the matter of the equipment of shops and enginehouses but when business picks up suddenly and the pressure of demand for cars and locomotives becomes acute then too the question of the adequacy of shop equipment becomes acute.

Two incidents have recently come to our attention that bring home a rather important lesson concerning shop equipment—both cases having to do with machine tools. Recently, in a back shop on a medium sized road it became necessary during a period of curtailed operations for several of the foremen to roll up their sleeves and turn out a couple of emergency jobs in the machine shop. Without giving too much thought to the implications of his remarks one of the foremen complained about the condition of the machine on which he had been doing the work and said that he didn't see how the regular machinist was ever able to to do a good job on such a machine.

Here were four lessons driven home all at once: first-hand knowledge concerning the actual and inadequate condition of an obsolete machine tool; the realization that a highly paid mechanic had been working under the handicap of poor tools; the consciousness on the part of the foreman that he was the one who was responsible for the condition of that machine and that it is his responsibility to recommend its replacement; and finally the knowledge that an obsolete tool not only throws away the company's money but stands in the way of maximum output when the pressure is put on.

The other incident comes from a machine tool salesman who reports having tried for over five years to sell a new machine in a certain railroad shop to replace one that is over 30 years old. The old machine had been repaired again and again until it is no longer possible to fix it in a manner that would make it possible to do accurate work. Still the shop engineer insisted that he could not recommend the purchase of a new machine because the net savings to be expected from it amounted to such a small percentage of the necessary investment.

"What are you going to do when the machine finally gives out completely?" asked the salesman. "Well, then we'll have to buy a new one, I guess," was the reply. And, this incident well portrays the situation in many shops. Many of the shop tools have gone beyond the point where they can deliver the output and the accuracy demanded today. Faced as they are with the need for making every repair dollar do the work of two the roads should quickly survey the shop situation and acquire the necessary replacement units without delay.

Training of Supervision

A unique experiment was made at the Conference on Human Relations in Industry at Silver Bay, N. Y., last month. A group of foremen from several industries sat about a table on the platform and discussed before the audience the question of what supervision expects of management. A by-product of this discussion was the apparent fact that when these men started in as supervisors—not so many years ago by the calendar, for apparently none of them was near the age of retirement—the common conception of a foreman was a hard-fisted driver. Today, on the other hand, although some of the old-fashioned foremen are still doing business, the general conception of a foreman is that of a man who understands human nature and is skilled in dealing with it. True, he must understand thoroughly shop methods and practices and the technical side of the job. Not the least of his functions, however, must be that of so dealing with the workers as to maintain their confidence and secure maximum performance from them.

The mechanical department is now busily engaged in enlarging its personnel, and undoubtedly it will be necessary to furnish additional supervision as its activities expand. Unfortunately the practices of the more advanced industries in selecting and training supervision have not been followed in the railroad mechanical department. Many industrial organizations keep a careful record of the performance and abilities of the work-

ers and are prepared at all times to make promotions from the ranks. Such promotions are not made on the record of the worker solely on the basis of his technical and craft ability, but he must possess those talents which are necessary for a successful supervisor. Moreover, when he is promoted he has either already received some coaching in how to handle the human element, or steps are immediately taken to see that he does receive training of this sort.

Very, very few efforts have been made by railroad mechanical departments either to be prepared promptly and with assurance to select men for promotion, or to train them to succeed as supervisors. If industry has found it a paying proposition to see that the supervision is properly trained, the same thing should also hold true of railroad organizations.

A wealth of helpful material is available. In some communities the railroad supervisors can take advantage of foreman training courses or executives clubs conducted by men from the industries in the same district. In other instances, capable instruction can be furnished for a group of railroad men at reasonable cost, which undoubtedly would be many times repaid in the increased efficiency and effectiveness of the supervisors.

The railroads will face a pretty stiff proposition in the months to come and the mechanical department must bear a large share of the increased burden. Surely no stone should be left unturned to prepare adequately to meet the situation. The training of supervisors is of first importance and is a paying proposition under any conditions, but of vital importance under present conditions.

Riding Qualities of Passenger-Car Trucks

On another page in this issue will be found a thoughtful discussion of the riding qualities of passenger-car trucks. The author, Dr. Giesl-Gieslingen, is favorably known to many of our readers as an engineer, which means that his approach to such a problem is quite the reverse of superficial.

Several railroads in the United States have already been working on the improvement of trucks to produce better-riding passenger cars of conventional weight as well as of the lightweight variety, and they have, no doubt, closely approached, if they have not arrived at, an agreement with the author's statement of fundamentals. In the main, however, the need for improvement has become evident where speeds have been most sharply increased. Since such increases in speeds have largely been associated with lightweight trains, interest in the question has not spread far beyond the roads where these trains are in service.

As schedules are more and more widely stepped up, the consciousness that conventional trucks are not the last word is bound to spread. This will occur not alone because of the increase in rates of acceleration of oscillations normally to be expected with increases in speed, but because a whole crop of new critical speeds will be encountered at which oscillations build up to violent proportions.

These two conditions—i.e., the increase in acceleration rates of normal oscillations and the entering of a range of new critical speeds—suggest two of the fundamentals touched on by the author of the article in question: first, the need for softer springs which increase the amplitude but reduce the rate of acceleration of oscillations; second, light, rigidly aligned truck frames with little or no spring protection from the axles, to eliminate critical speeds arising from lateral periodicity of the truck and the vertical oscillatory periodicity of the truck frames on the journal-box or equalizer springs.

Supplying softer springs has not proved a difficult problem. To produce a passenger-car truck frame light enough and strong enough so that neither it nor the journal bearings need protection from road shocks is less simple. In approaching this problem, however, it should be remembered that in each pound of weight lies the source of the inertia force against which the structure of which it is a part must be protected, and that weight poorly distributed adds less to the strength of the structure than it does to the force which tends to destroy it.

Economies From Streamlining

The general opinion of railway engineers in this country is that the value of streamlining a locomotive rests fully as much, and probably more, in improved public appeal than it does in reduced fuel consumption. With proper design, however, it cannot be questioned that a certain amount of decrease in head-end air resistance is experienced. In that connection, some figures, originally published in a German technical paper and quoted in the Railway Gazette of London may be of interest.

According to the article quoted, tests of a Class-03 standard two-cylinder Pacific locomotive of the German State Railway, showed that this locomotive, fully streamlined and operating at 62 m. p. h. can develop 1,455 drawbar horsepower, against 1,375 drawbar horsepower for a partly streamlined locomotive and 1,260 drawbar horsepower for an unstreamlined locomotive. At 87 m. p. h., the gain had increased to 385 drawbar horsepower, equivalent to 48 per cent, the maximum outputs being 1,185, 1,015 and 800 drawbar horsepower, respectively.

With the relatively larger Class-05 Pacific locomotive used on the fast Berlin-Hamburg runs, the coal consumption per drawbar horsepower hour was said to average 2.45 lb. at speeds of 60 to 62 m. p. h., as non-streamlined Class-03 locomotives have a consumption at the same speed of 2.75 lb. At a speed of 100 m. p. h.

the 4-6-4 locomotives consume 3.35 lb. per drawbar horsepower. Experience with the Class-03 Pacifics over a year in ordinary service, which includes both fast running and quite an appreciable proportion of slow running, is said to confirm the value of streamlining, the economy in coal consumption per mile being 11.5 per cent, and per-ton mile 15 per cent.

What Car Men Are Thinking About

Both the Chicago Car Foremen's Association and the Northwest Carmen's Association devoted their opening Fall sessions to the discussion of various questions and problems associated with the interchange of freight car equipment. The views expressed did not pretend to be authoritative, but were simply submitted as information with a view to correcting misconceptions and clarifying viewpoints about various phases of interchange rule applications.

Typical of some of the questions asked were the following: Why is it necessary to scrap an axle on account of a long journal, or worn collar? What facts justify placing the responsibility for cut journals on the handling or delivering line? If dust guards are essential and mandatory in the event of wheel changes, why should they not be maintained when the truck is dismantled for bolster or spring plank repairs, and a charge permitted if defective? What is the minimum and maximum standard practice height between the top of the coupler shank and the bottom of the buffer or deadwood? In charging for the application of safety bars by welding, is the welding on each side of the spring plank considered a new weld? What is the correct way to determine whether the flat spot on a car wheel is new or old? Why should not slid flat wheels, in connection with defective air brakes, be considered an owner's defect? Is it proper or improper to make out a defect card if a tank car has a metal plug screwed in place instead of a safety valve, this metal plug evidently having been applied when the tank car was built?

Some interest may attach to the answers given to a few of these typical questions. For example, in reply to the query about scrapping axles on account of long journals, the thought was expressed that a great deal of money is being wasted at the present time by scrapping journals which are over the wear limit in length, due to collar wear, and that it might be feasible to save a large proportion of this expense by the application of journals without outside collars, a design which is said to have given good results in test service on cabooses and other special cars. In this connection, apparently not enough attention is being paid to the smooth refinishing of collars after being cut, with the result that the rough surfaces cut into the brasses, causing excessive wear and subsequent early scrapping.

The question of making car owners responsible for cut journals keeps bobbing up from time to time and there is apparently increasing sentiment among many practical car men that the advantages of this radical change in previous practice might offset its disadvantages. The subject has been carefully considered in the past, however, by the A. A. R. Arbitration Committee and it is doubtful if the present rule will ever be changed, owing to the fact that cut journals are due to many causes, some of which, including waste grabs, are the result of operating conditions and cannot fairly be charged to owners, especially when they are private car companies.

In discussing push-pole pocket damage, which is an owner's defect, the question was asked if repairs are chargeable against the owners when associated with safety appliance damage, and is the latter chargeable to the owner. There was some sentiment to the effect that safety appliance damage in connection with damage to the push-pole pocket would make it a handling line responsibility, but the preponderant opinion was that two owners' defects do not make a delivering line defect. In other words, push-pole pocket damage is an owner's defect, and safety appliance damage is an owner's defect, unless involved with other delivering line defects; therefore, push-pole pocket damage and safety appliance damage, with no other Rule 32 condition, would both be owner's defects.

The discussion of these and other similar questions before the various associations of railway car foremen throughout the country serve a definitely useful purpose and should be encouraged, always with the understanding, of course, that the answers to the questions are accepted with reservations, as the A. A. R. Arbitration Committee is the final authority.

The Laboratory and Service Performance

In the last analysis, the best-equipped laboratory cannot of course duplicate service conditions which provide the rigid yard stick by which the performance of all types of new railroad equipment and appliances must be measured. It is especially unwise to draw hard and fast conclusions from laboratory tests of small-scale models which, however, have the advantage of being less expensive to conduct and frequently serve a very constructive purpose in pointing the way to improvements in design which may subsequently be given the acid test of road service.

One of the principal advantages of carefully conducted laboratory tests is that the test conditions can usually be controlled so as to study one variable at a time and analyze its effects. While any conclusions drawn must be subject to subsequent check in road service, it cannot be questioned that laboratory tests, utilizing the modern testing equipment and methods, take much of the guess work out of problems associated with the design of railroad equipment and appurtenances and hence serve a most useful purpose.

IN THE BACK SHOP AND ENGINEHOUSE

Shop Lifting Devices—Factor of Safety

By A. D. Hollis

Right now is a good time to check over shop-lifting devices for proper factor of safety; to anneal them, to whitewash and hammer-test the stressed parts. In examining shop-made lifting tools it will be found that most of them have an excessive factor of safety, and are so heavy that they are awkward to handle. This is not usually a serious defect, because railroad tools are subject to all kinds of abuse. Occasionally, a shop-designed tool will be found with a very low factor of safety. Locomotive parts are heavier than they were 20 years ago, and the crane attachments may not have kept up with the procession. High wheel locomotives have come back and tires and wheels have greatly increased in weight.

Proper Factor of Safety

The ratio of the ultimate strength of the material to the working stress is the factor of safety, a term which, for several reasons, is misleading. A tool or structure with a factor of four cannot resist successfully loads four times as great as the maximum specified for safe working stress. Deformations will occur. In use, the factor of safety is really a divisor. The factor of safety is derived by taking the product of four other factors. The first of these is the ratio of the ultimate strength of the material to its elastic limit, somewhat less than two in the case of iron and steel; so this factor is considered to be two. The second factor depends on whether the load is static or variable. This factor is one (or may be omitted) for a steady load, and is two for a load varying between zero and a maximum such as occurs in connection with crane hooks, chains, etc. If the stress alternately is tension and compression (at the piston rod of a steam engine), then this factor is three. The third factor concerns the method of applying the load, and for suddenly applied loads (not impact loads) is two. The loads occurring in crane operation are sudden loads. Another factor is sometimes added to cover unknown conditions like deterioration, overloading, etc. The first three factors (two times two times two) have produced a factor of safety of eight, which appears to allow an excessive margin of safety as shop tools are supposed to be intelligently used and inspected.

Figure 1*A* shows a convenient tripod-like arrangement of hooks used to handle locomotive tires. As in the case of a chain cluster, the angle at which the stressed members are used increases the stress and reduces the factor of safety. The central member to which the legs are attached is ruggedly designed and may be a forging, or a piece of ⅝-in. boiler plate cut and bent to suit, and has an excessive factor of safety. The legs are flattened at the upper end, where the pin hole is drilled, so that they will not fail by pulling out at the eye. The capacity of the device is limited by the shearing strength of the three pins that secure the legs to the central member, and is not difficult to figure. The stress is greatest when the legs are spread wide, as is necessary to handle the largest locomotive tires.

An 80-in. (outside diameter) driving wheel tire 3¾ in. thick weighs about 1,600 lb. . If the tire could be lifted with the legs straight this would place a load of 533.3 lb. on each leg of the hook cluster. Used at an angle of 15 deg., as shown, the tensile stress on each leg and the shearing stress on each pin would be 2,059 lb. The stress is inversely proportional to the sine of the angle at which the stressed member is used. If ⅝-in. rivets were used for pins the tool would have a factor of safety of more than 5 when used at an angle of 15 deg.

This tool might be overloaded by using it to handle a tire and wheel assembled. The weight of a large main wheel center, including the lead in the counterbalance and the tire, would be about 5,700 lb. When used with the legs at 15 deg. this would place 7,330 lb. shear on each pin, and the ⅝-in. rivet would then have a factor of about two, which is not safe; for a factor of from six to eight is considered the proper safety factor for lifting tools not subject to shock loads.

At *B* is illustrated a common and convenient type of tire-lifting C-clamp used to handle hot tires on to the wheel centers with the crane. The ⅝-in. chain will break at 20,000 lb. and has a factor of 12.5 (the heaviest tire weighs about 1,600 lb.). The ¾-in. by 2-in. lug which supports the tire looks like the weak part of this clamp. The area of this lug in shear is 1½ sq. in., and ordinary steel of this section will support over 50,000 lb. in shear. A tire weighs only 1,600 lb., but the factor is not as excessive as it appears, for the weight is applied at the corners of the lug and in handling tires onto the wheel centers the clamp and its attached chain may raise the wheel from the horse for a few moments, and support half the weight of a pair of mounted wheels. Occasionally it may be subject to shock loads.

The attachment *C* is used in connection with a crane to apply rods to locomotives, and to make other lifts under the running board or elsewhere, where the crane hook itself cannot be brought into position directly over the part to be lifted. The loop on the upper end is passed over the crane hook and a suitable chain is passed through the bottom loop. The greatest stress is in the long vertical member and at the 90-deg. bends. The section of the horizontal members is increased where farthest from the load to approximate a beam of constant strength. The heaviest rods weigh about 1,000 lb., and, without going into theory or calculations, experience has proven a maximum section of about 2 in. wide by 3 in. deep is satisfactory for this hook.

The hooks, shown at *D* and *E* are very useful around the shop. *D* is made in various sizes, and if large enough may be used for handling stoker elevators inside the cab. The liberal dimensions permit it to be passed under the cab roof from the rear. In a smaller size it may be used for putting up pumps under the running board. *E* is a specially-designed hook used for lifting tires without flanges out of the heating pit. Its peculiar shape permits passing it under a tire that has been blocked up a few inches.

Two views are given of a special device *E* for putting up air pumps and feed water pumps under the running boards. It is attached to the pump by two steel studs, having a pipe thread at one end, that are screwed into

(*Continued on page 405*)

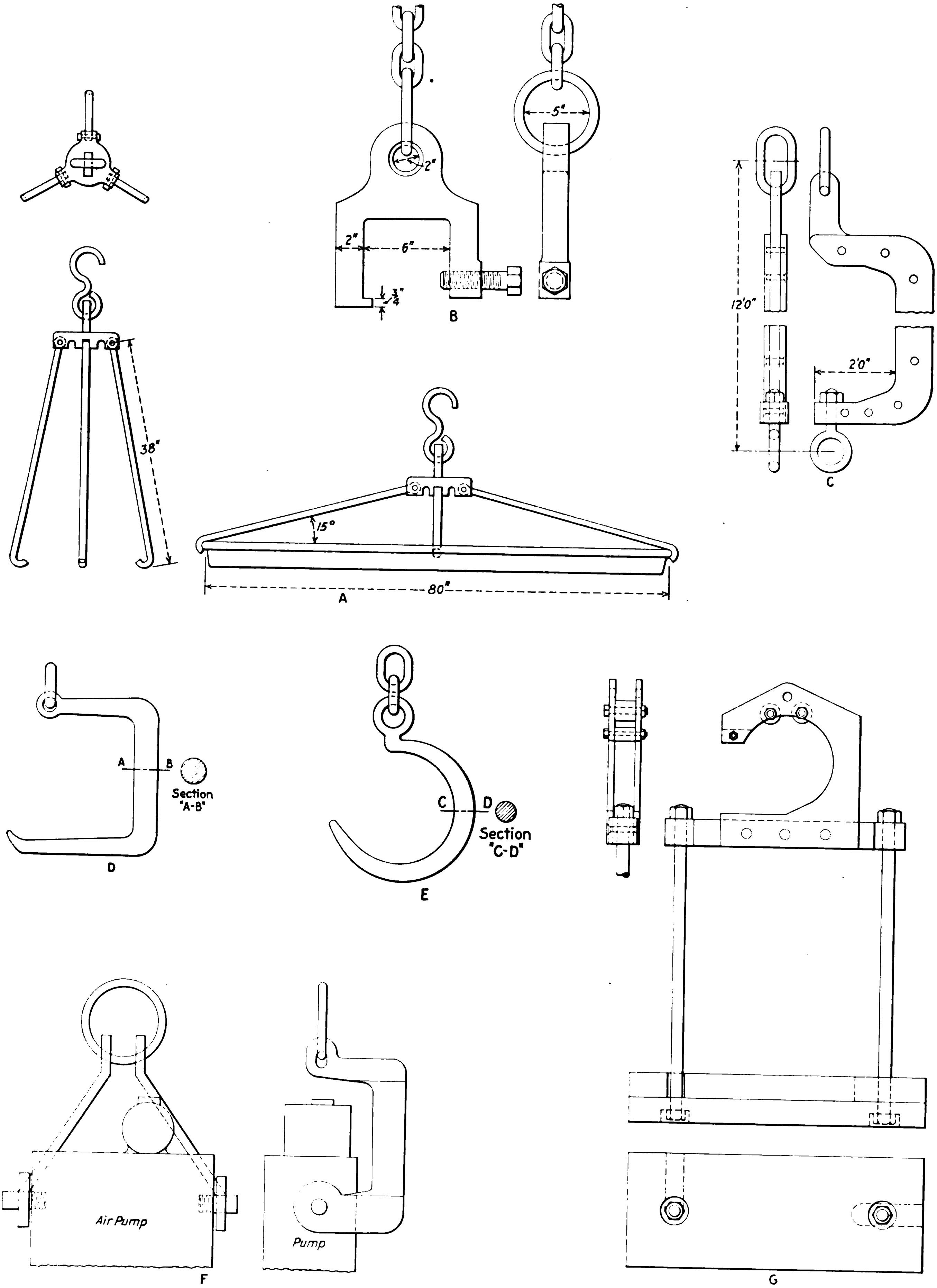
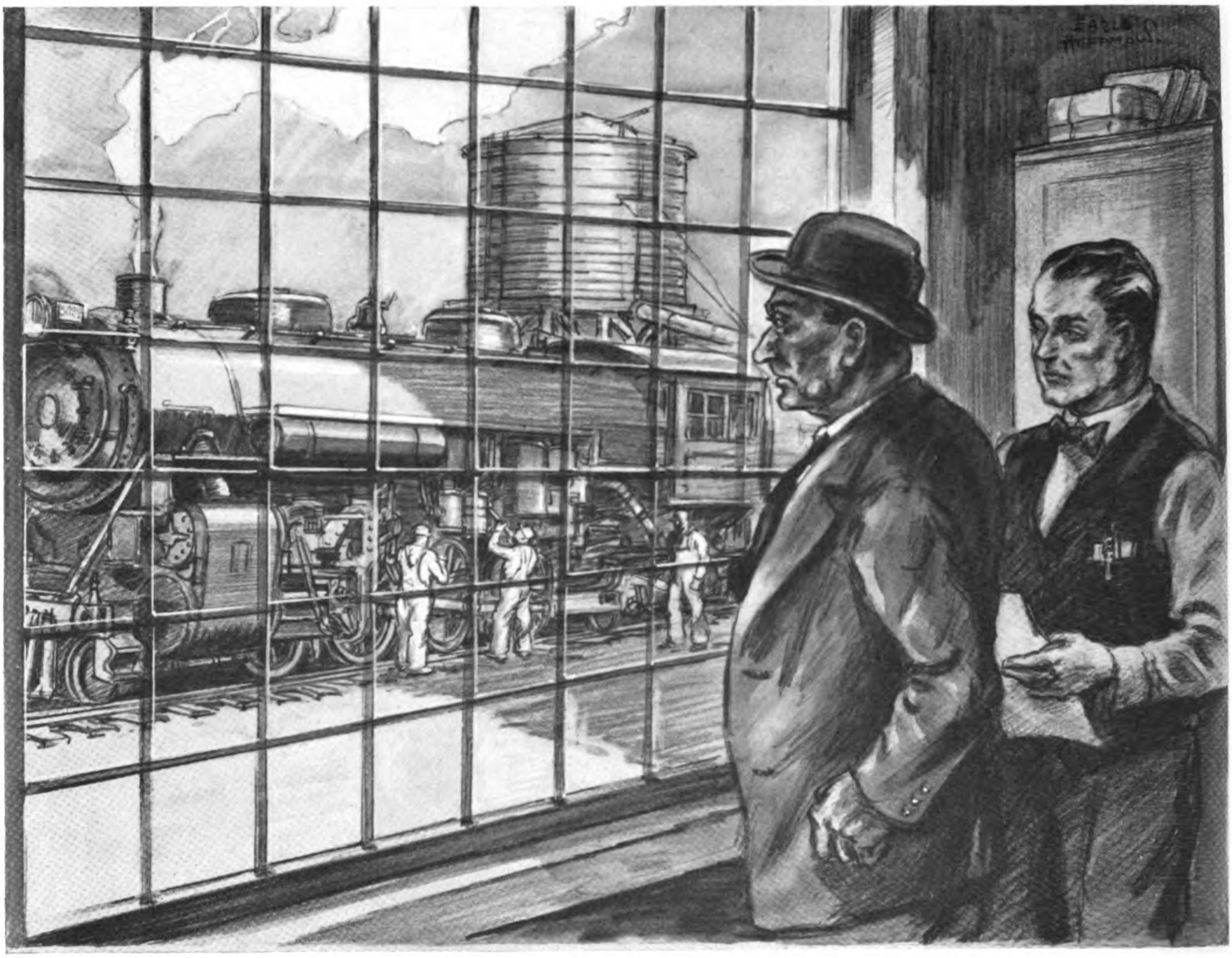


Fig. 1—Special devices for use with a railroad shop crane in lifting (A) and (B) driving wheel tires, (C) driving rods, (D) stoker elevators, (E) bald flange tires, (F) air pumps, (G) counterbalance weights



Jim, the roundhouse foreman, watched the procedure through a window in the roundhouse office. "Dammit," he said, "if we had a couple more engines we wouldn't have to finish repairs while the engineer is oiling around."

Some Gadgets Work

by

Walt Wyre

THE 5088 was called for an extra west at 3:30 p. m. The hostler took the engine out of the roundhouse at 2:45. She had nearly a hundred pounds of steam and the air pump on the left side was hanging on with two bolts. A machinist and a pipe fitter followed the engine around while the hostler and his helper took on water, fuel oil, and supplies. Every time the engine stopped, the machinist would take a few turns on a nut and the pipe fitter would smear graphite on pipe threads and make another attempt to connect a union.

Jim, the roundhouse foreman, watched the procedure through a window in the roundhouse office. "Dammit," he said, "if we had a couple more engines we wouldn't have to finish repairs while the engineer is oiling around. Guess I'd better send some one out to help the pipe fitter. He seems to be having trouble getting the pipes connected."

"Did you see this letter from the superintendent?" John Harris, the roundhouse clerk asked. "He's hollering about engines not steaming."

"Yeah," Evans replied. "I saw it. I got another from the road foreman of equipment. He says some of the engines are not lubricating and they're foaming pretty bad."

The foreman went to the roundhouse and told another pipe fitter to lend a hand on the 5088. He took a turn through the roundhouse, then went out to see how the 5088 was coming along.

The mechanics were gathering up their tools getting ready to come in when Evans got there. He walked around the engine and at the same time made a mental note to put her over the drop-pit soon as possible. Driving boxes were badly worn, some of the tires looked like a gauge would condemn them.

Fifteen minutes later the 5088 pulled out from the lead, crossed over the main to number one track and coupled on to one hundred and fifteen reefers. The switch engine had already pumped up air on the train

and it was ready to leave almost as soon as the engine was coupled.

It is slightly up grade going west out of the Plainville yard, but the hoghead cut the booster in and the 5088 started the 115-car train with hardly a jerk.

"Thought maybe I might see the switch target dragging along behind the caboose," Evans remarked as he watched the train pull out. "They took everything else in the yard."

"And they holler about engines not steaming!" John Harris added.

"If Stevens, the engineer, forgets to use the blow-off cock pretty regular, they'll be hollering about her foaming, too," Evans said. "She was reported for a boiler wash when she came in but didn't have time; had to just change the water and let her go."

Both prophecies came true. The train had to double the hill at Monroe, then they couldn't make Lake View for the Limited and had to go into a 75-car siding at Clay switch. The Limited was delayed fifteen minutes sawing by the extra.

Next day the road foreman came in with a report long as a street walker's dream. Then he hunted up Evans and told him about the engine.

"Outside of the engine pounding all over, the boiler is dirty as a smoking car joke," the road foreman said. "If it hadn't been for the booster, the sixteen-hour law would have caught them before they got in," the road foreman said.

"Yeah," Evans bit off a piece of horseshoe about the size of a one-inch nut, "they hang all the cars this side of Chicago on a locomotive and expect to make passenger train time. On top of that, we haven't got enough engines and don't have time to get the work done."

"Maybe you're right," the road foreman admitted, "but that's what they want and that's what they're going to have to satisfy them. It's your job to see that the engines are in shape to go and my job to see that they get over the road or explain why."

"Yeah, and they keep expecting more all them! Used to be a foreman was scared to death when he had to turn an engine that had run over a hundred mile division without working it, now they expect one to run twelve or fifteen hundred miles, stay in the roundhouse six or eight hours and keep on doing that for months."

Evans went to the roundhouse leaving the road foreman in the office.

Business began to pick up on the S. P. & W. Cattle were being rushed to market to take advantage of a good price and they had several extra passenger trains each week of tourists returning from the Fairs.

The 5088 made one trip too many and broke a main pin. Then the engine was run over the drop-pit for overdue classified repairs. The wheels were ready to go up and they expected to break her in on the west local next day when a large box was brought into the machine shop from the storeroom.

"What's that?" Evans asked the portable crane operator who brought the box in.

"Don't know," the crane operator replied. "The storekeeper said to deliver it to you. I thought it was some special material you were needing right away."

"Open it up and we'll see what it is," the foreman told a machinist.

The nut-splitter cut the wires that bound the box and pried the cover off with a bar.

"Whatever it is, it surely is well packed," the machinist said when he saw half a dozen cardboard cartons packed in excelsior.

Evans opened one of the cartons. It was filled with electrical fittings, junction boxes, connectors, a fuse receptacle, toggle switch, and several other dinguses the foreman didn't recognize.

"It must be something the electrician ordered," Evans said replacing the lid on the cardboard box.

"This don't look like anything electrical." The machinist pulled out what looked like an overgrown Dutch oven without a lid. "It's got two places to connect pipes."

While the foreman was puzzling over the contents of the box, H. H. Carter, the master mechanic, came in. "Well, I see you got it," the master mechanic said.

"That's right, but damned if I know what it is," Evans replied.

"It's an automatic blow-off system." The master mechanic dug into the large box and brought out a fair sized one of cardboard labeled "glass." Fitting snugly in the cardboard box was one of iron with a hinged door. There were two bulls eyes, one red, the other yellow in the door of the iron box.

"Looks like some kind of signal," Evans said.

"You are partly right," the master mechanic said as he unscrewed the wing nut that held the door closed. "It's a signal and the apparatus that operates the blow-off, too. When the boiler gets to foaming, the yellow light comes on. A jigger in here makes an electric connection that opens an air valve. The air in turn opens a blow-off valve."

"Sounds kinda complicated," Evans said. But what's the red light for?"

"If the foaming gets too bad and gets where it's likely to cause priming, the red light comes on. That's a signal to the engineer to help things out by opening a hand operated blow-off cock. It's not very often that's needed."

"What are we going to put it on?" Evans asked.

"Put it on the 5088," Carter said. "You've got her tied up on the drop-pit."

"But I was figuring on getting the 5088 finished today and breaking her in on the west local tomorrow," Evans said dolefully.

"Better hold her and put the outfit on," the master mechanic said. "The superintendent of motive power wants it put on soon as possible," he added.

Evans groaned. Holding the 5088 meant revising the engine lineup for tomorrow with nothing to use in place of the 5088. The 2746 that had been on the west local was due a monthly inspection and a two-year test besides. He was rushing the engine on the drop-pit because there was nothing else for the local, but he knew by Carter's tone of voice there was no use arguing the point.

"Blue-prints for installing the outfit are in my office," the master mechanic said. "Better get started on it pretty soon."

"O. K., I'll go down and get them in a little while."

Evans went to the roundhouse office and sat down in a chair with a thump that threatened to drive his seat through that of the chair. "Things have sure come to one hell of a pass on the railroad!" he snapped.

"Now, what's the matter?" the clerk asked without a great deal of interest.

"It was bad enough when they put on air reverse gears and automatic whistle blowers; now I've got to hold the 5088 to put on an automatic blow-off arrangement! Next thing you know they'll have an automatic nose wiper for the engineer when he's got a cold! I don't see why the engineer can't open the blow-off cock when an engine gets to foaming bad enough to need it!"

"What are you going to run on the west local tomorrow?" the clerk asked.

"Wish I knew! The way it looks now there won't be any west local tomorrow."

"The dispatcher asked me a little while ago what we had for the local tomorrow. When I told him the 5088 he said O. K. Must be figuring on a heavy train," the clerk added.

"The only thing I can see now is to drag the 1879 out of storage," Evans said. "It might drag thirty cars but it wouldn't handle many more than that. Guess I might as well go to the master mechanic's office and get the prints on that outfit."

The master mechanic had the prints laid out on a desk looking them over when Evans got there. "Doesn't look like that outfit is going to be so complicated to install," Carter said, "just a couple of small holes in the top of the boiler and a little piping and wiring."

"Looks like we ought to make it in two or three days," Evans admitted after he had looked over the blue-print. "I'll get started on it right away." He rolled up the prints and went back to the roundhouse.

Bill Cox, a machinist, Ned Sparks, the electrician, and two pipe fitters, Sam Crawford and Steve Williams were given the job of installing the automatic blow-off system. There was more pipe work than anything else, but the pipe fitters couldn't do much of it until the machinist had mounted the various parts of the equipment.

Cox made templates for brackets to mount the control box and the solenoid air valve while a boilermaker was cutting and tapping the two holes on top of the boiler just back of the steam dome for the two electrodes that controlled the height of foam in the boiler. In the meantime Sparks was cutting the right handrail to put in a junction box to connect conduit for the wires from the electrodes.

With the gang installing the automatic blow-off and two drop-pit machinists and their helpers working on the engine, it looked like a government job. Fortunately the work was distributed over the engine so that there was less interference than might have been expected and work was progressing nicely.

About 3:15 Evans came out to see how things were coming along. He found that the wheels were up and rods just about finished. The control box for the blow-off was mounted in the cab as was the solenoid air valve. The holes in the boiler were drilled and tapped for the electrodes and the iron pot that resembled a Dutch oven was mounted on top of the boiler just ahead of the cab. The latter Evans had learned was something like a muffler and separator to reduce the velocity of the blow-off steam and separate steam from water. A pipe from the separator extended down the side of the boiler and connected to a funnel shaped discharge about ten or twelve inches higher than the top of the rail. The discharge which wasn't yet connected would be about even with the ends of the ties.

While the foreman was watching the work on the 5088, the roundhouse clerk came rushing out like a Scotchman who had heard of free lunch with beer thrown in. "Say!" the clerk panted, "I told the dispatcher what you said about running the 1879 on the west local tomorrow and he blew up like a peace conference in Europe!"

"What did he say?" Evans asked.

"I can't remember all he said, but he wants a big engine on the west local in the morning. He wants to talk to you."

"Dad blast it!" Evans snorted. "If they would just give us a few engines instead of spending the money buying doodads to make things easier for engineers, I might have a big engine when it's needed!" He started to the office to talk to the dispatcher.

After the foreman talked to the dispatcher it was easy to see why the 1879 wouldn't do for the local. In addition to about forty cars of stock to be picked up, twenty-odd cars of merchandise and half a dozen cars of oil a contractor was moving, eight cars of heavy equipment to be picked up at Anderson spur, the 1879 couldn't pull that much train on level straight track.

"I'll see what I can do," Evans told the dispatcher and hung up.

The foreman checked over every engine in the house and all he had left for the local was either the 1879 which was out of the question or the 5088 and he didn't see how it could be finished.

Evans went back to the drop-pit. He found the men all working away without the discussion and argument that was usual when a new piece of apparatus was being installed.

"Looks like you are getting along pretty well," Evans said to Cox.

"Yes, that outfit looks complicated, but it's not so bad. The blue-print shows every thing so clear we are not having any trouble with it."

"How long will it take you to finish your part?"

"Oh, I'd say two or three hours by pushing a little," the machinist replied. "The pipe fitters have quite a bit, though, and I don't know just how much the electrician has."

Evans was again agreeably surprised when he learned that the electrical work could be completed in four or five hours with some one to help the electrician pull in the wires and test for connections. The pipe fitters said the night man would be able to finish the pipe work if he didn't have too much on running repair work.

"Well, I'll be damned!" Evans said. "I thought it would take two or three days at least to get all of that apparatus hung on an engine."

He went back to the office and told the dispatcher he could have the 5088 for the west local.

The road foreman called and said he would ride the engine next morning. He usually rode ones just off the drop-pit and he wanted to see how the new automatic blow-off worked.

It was a heavy day for the local. There was work at every station and they picked up more than they set out at every station until by the time they reached Monroe they had seventy-nine loads.

"Can we make it in ahead of the Limited?" the conductor asked the engineer.

"If this hog keeps pulling like it has been, we can," the engineer said. "If we stay here for the Limited, the sixteen-hour law will get us."

"What about Clear Creek hill?" the conductor asked. "If we have to double that, we'll lay the Limited out and the sixteen-hour law catch us besides."

"It's a pretty tough grade, and we got a heavy train, but I believe she'll make it," the hoghead said. "What do you say we try it?"

"O.K.,—high ball."

If the engineer had known that the last tank of water he took had not been treated he wouldn't have been so confident. The treating plant is automatic and no one had discovered that it had not been working for some time. And the water at Monroe is awful bad, it requires very heavy treatment for boiler use.

Both the engineer and the road foreman noticed soon after leaving Monroe that the yellow indicator light began to show more often and the automatic blow-off to operate. Once when the engine was working hard the red light came on. The engineer opened the hand operated blow-off and both lights went out indicating that danger of priming was eliminated. A brisk wind came up from

the southwest just before the train started down the hill towards Clear Creek.

"Better hit it pretty hard," the road foreman yelled to the hoghead. "It'll take all we got to get up the hill."

The engineer nodded and widened on the throttle. When he crossed the bridge the train was going at least five miles an hour over the speed limit for freights of fifty miles an hour, but it didn't hold that speed long. The curve and grade west of the bridge reduced the speed by half in two train lengths and they hadn't reached the steepest part.

Gradually the train slowed down until each exhaust was a slow cough. The engineer cut in the booster and the engine gained a little speed.

"Going to make it!" the engineer said. "A hundred yards more and we'll be over the top."

At that moment the yellow indicator light came on and the automatic blow-off opened. The water in the boiler was foaming.

Two days later the road foreman was telling Evans about it. "If it had not been for that automatic blow-off we would never have made it over the hill. We took over half a tank of water at Monroe that hadn't been treated."

"Couldn't the engineer open the blow-off cock when it needs it?" Evans asked.

"The engineer could," the road foreman replied, "If he could see inside the boiler and tell when it needs it. By the time the engine starts slopping over damage is already done. The automatic blow-off works from the inside and operates before foaming is bad enough to cause trouble. It'll cut boiler washing in half or more and increase the efficiency of an engine."

"Guess they're all right," Evans admitted. "Wish they would equip all of the engines. Maybe they would stop some of the complaints about engines not steaming and not lubricating."

"They would help a lot," the road foreman said.

Safety Factor of Lifting Devices

(*Continued from page 400*)

the pipe openings of the pump. An 8½-in. cross-compound air compressor weighs 1,600 lb. and a feed water pump (Elesco) weighs 1,835 lb. If these lifting hooks are made out of ¾-in. by 3-in. flat iron, the factor of safety will be ample.

A frame with a roller-bearing head is shown at *G*, being used for hanging weights on locomotive crank pins in counterbalancing. One side of the head is open, making the device appear like an inverted hook. This opening permits convenient handling on and off the pins by the crane. The hole at the top is used for attaching the crane chain by means of a ¾-in. pin. The section of greatest stress (opposite the open side) consists of two members ½ in. by 3 in. and has a factor of safety of 3.74 with a load of 2,600 lb., the maximum weight used.

The method of figuring the stress on the hook member of *G* follows: The distance from the center line of the device to the center line of the section of greatest stress (mentioned in the previous paragraph) is 8 in. (dimension not shown in the drawing). Obviously, 2,600 lb. times 8 in. equals 20,800 in.-lb., the bending moment.

The fundamental formula for beams, as given in various handbooks, states that stress equals bending moment divided by section modulus, S equals $\frac{MB}{Z}$. The two ½-in. by 3-in. sections that support the weight may be considered as one section 1 in. by 3 in. Further reference to the handbook shows that the section modulus of a rectangular beam is $\frac{bd^2}{6}$ when b is breadth of beam and d its depth.

Substituting the dimensions of the given beam:

$$\text{Section modulus} = \frac{1 \times 3^2}{6} \text{ or } 1.5$$

$$\text{Stress from bending moment equals } \frac{20{,}800}{1.5} \text{ or } 13{,}866 \text{ lb. per sq. in.}$$

The section is also subject to a straight tensile load of 2,600 lb. which, divided by the area of the section, gives 867 lb. per sq. in., which should be added to the unit stress, due to the bending moment. 13,866 plus 867 equals 14,733 lb. per sq. in. Assuming the tensile strength of steel to be 55,000 lb. per sq. in. the device has a factor of safety of 3.74.

Fig. 2 shows a bar used in connection with a traveling crane for handling locomotive wheels. The ends of the bar pass between the spokes, and with this bar the crane operator can pick up a pair of drivers in one part of the shop, handle them to another location, set them down on the track and disengage the bar without any assistance from the floor. The bar may be easily disengaged by the crane operator after the wheels are placd in a lathe or other machine.

The weight of locomotive wheels has increased in the last few years and crane equipment should be examined to see if it has the proper factor of safety. A pair of the heaviest main wheels assembled complete would weigh about as follows:

2 crank pins	1,200 lb.
2 eccentric cranks	400 lb.
2 wheel centers (72-in. diameter)	6,000 lb.
Lead in 2 counterbalances	4,000 lb.
2 tires (80-in. diameter)	3,200 lb.
11-in. axle assembled (housing and roller bearings	4,700 lb.
Total	19,500 lb.

An examination of the bar illustrated shows ample strength in the link connection as a 1¾ in. chain has a safe working load of 55,300 lb. This beam approximates a beam of constant strength and its strength (disregarding the hole in the center) may be calculated by the formula:

$$P = \frac{2\ Sbh^2}{3L}$$

Where

P = the load
S = stress in. lb. per sq. in.
b = the breadth of the beam (2 in. in this case)
h = the height of the beam
L = the length of the span

Substituting the actual values

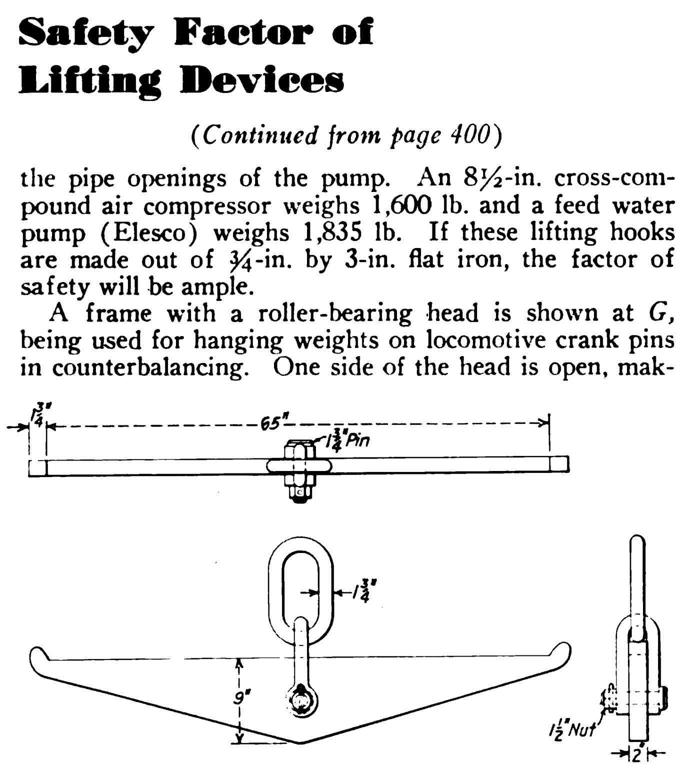


Fig. 2—General dimensions of a bar and link connections which may be safely used in lifting locomotive driving wheels

$$19{,}500 = \frac{2 \times s \times 2 \times 9^2}{3 \times 60}$$

(60 is the actual length of the beam for the load is applied 2½ in. from the end. The length shown in the figure is 65 in.)

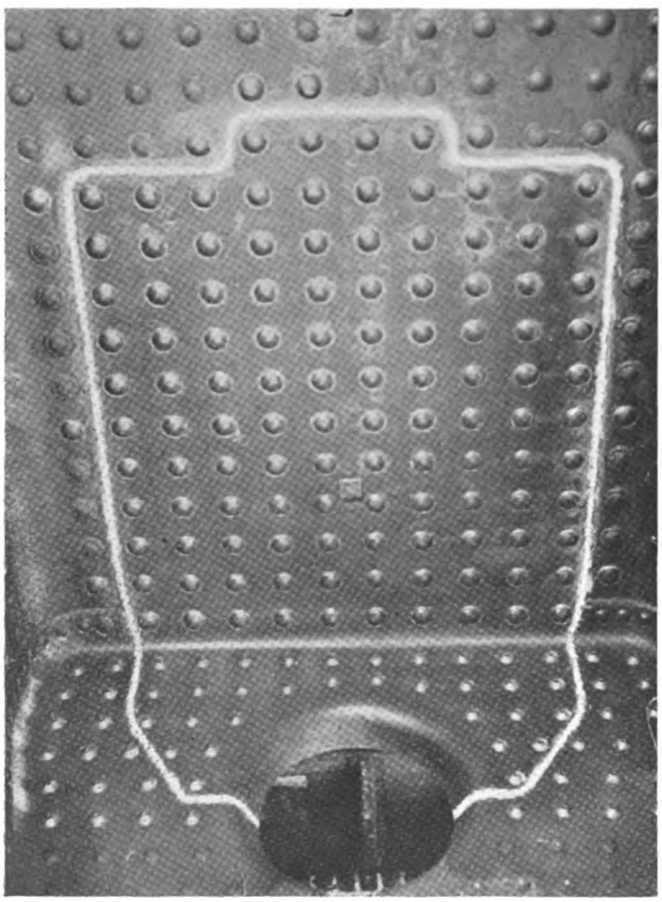
Solving

S equals 10,830 lb. per sq. in., and assuming the tensile strength of steel to be 55,000 lb. per sq. in. the bar has an apparent factor of safety of slightly more than five, which would be somewhat reduced by the hole in the center, but it will be more than four.

Unusual Boiler Patch On Argentine Locomotives

Ten Argentine locomotives have been fitted with boiler patches similar to the one shown in the illustration. E. Crapper, a member of the Master Boiler Makers' Association and chief boiler inspector of the Buenos Ayres Southern & Western, Argentine Republic, described this unusual patch in a letter to A. F. Stiglmeier, secretary-treasurer of the association.

The patch is fitted in a Belpaire boiler with a working pressure of 200 lb. per sq. in. which has the crown stays riveted over on the fire side. The patch extends to the fire-door opening in one piece and eliminates the riveted seam at the top of the inside door sheet for the width of the patch. As the distance from the intersection of the crown sheet with the door sheet was too great for safety, another row of ten stays was applied on the line of the old riveted seam. The electric welding was done entirely from the inside of the firebox. The rough appearance of the weld in the illustration is the result of marking the weld with chalk for photographic purposes.



A single patch welded to the crown and door sheets in the firebox of an Argentine locomotive

The locomotives are oil burners and previous to the application of these patches, a downward bulging of the riveted seam occurred at the top of the inside door sheet, together with bulges in the sheet between the crown stays at the back of the firebox and between the stays over the door opening. Since the first of these patches was applied in 1930 no trouble has been experienced with them.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Is It Permissible to Weld Bracket Studs to the Boiler?

Q.—Is the use of studs welded to the shell or firebox of a locomotive boiler permissible?—F. L. C.

A.—The use of studs welded to the sheet instead of drilling and tapping the sheet for the stud, depends a great deal upon the purpose and location of the stud. Welded studs are being used to some extent by some railroads.

Welded studs for small pipe clamps or miscellaneous brackets, other than running-board brackets, on the firebox, backhead and throat sheets, would be permissible. However, before applying welded studs to the shell of the boiler, it would be advisable to secure the approval of the local I. C. C. Inspector or the Bureau of Locomotive Inspection.

Calculating the Thickness of Steam Pipes

Q.—Please give formulas for computing the thickness of steam pipes?—M. F. R.

A.—In determining the thickness to be used for pipes at different pressures and for temperatures not exceeding 750 deg. F. for steel or iron pipe, and 406 deg. F. for brass and copper pipe, the A. S. M. E. Boiler Construction Code provides the following formulas. For pipes having nominal diameters of from ¼ in. to 5 in.:

$$P = \frac{2S}{D}(t - 0.065) - 125$$

For pipes of nominal diameter over 5 in.:

$$P = \frac{2S}{D}(t - 0.1)$$

where P = working pressure in lb. per sq. in.; t = thickness of pipe wall, in.; D = actual outside diameter of pipe, in.; S = 12,000 lb. per sq. in. for seamless medium carbon-steel pipe; S = 9,000 lb. per sq. in. for seamless low-carbon steel pipe; S = 7,000 lb. per sq. in. for lap-welded steel pipe; S = 5,000 lb. per sq. in. for butt-welded steel pipe; S = 5,300 lb. per sq. in. for lap-welded wrought-iron pipe; S = 4,500 lb. per sq. in. for butt-welded wrought-iron pipe or for brass pipe and S = 4,000 lb. per sq. in. for copper pipe.

With the Car Foremen and Inspectors

Union Pacific Builds

Lightweight Box Cars

First order for 2,000 fifty-ton cars will be completed in October — 2,000 additional cars authorized

Stencilling one of the new Union Pacific 50-ton box cars recently built at Omaha shops

IN MAY of this year, the Union Pacific started work on an extensive car-building program involving the construction of 2,000 fifty-ton box cars which included 1,900 Class B-24 cars and 100 Class B-25 cars, the latter being unique in that they are especially designed and equipped for Challenger high-speed merchandise freight service. The entire order for 2,000 cars was allocated for building at company shops as follows: 600 cars at Omaha, Neb.; 700 cars at Grand Island, Neb.; and 700 cars at Portland, Ore. It is expected that this car-building program will be completed by the latter part of October, at which time work will be begun on an additional order of 2,000 cars, practically identical with the B-24 design.

The 1,900 Class B-24 cars embody lightweight construction of modified A. A. R. design for general freight service. No attempt was made to design the lightest car possible, but the objective was to design a light car which would give the greatest number of years service with a minimum of repairs and also to provide a car which would afford the best possible protection to the lading.

As shown in the table, the new Class B-24 box car has a lightweight of 39,700 lb. which may be compared with 45,100 lb. for an earlier type of Union Pacific box car (Class B-19) of A. A. R. design, incorporating riveted open-hearth steel construction, fully lined and having the same size and cubic capacity. The total saving of 5,400 lb. includes 3,480 lb. in the car body due to the use of low-alloy high-tensile steel and welded construction in the underframe; also 1,920 lb. in the A. A. R. spring-plankless trucks which have low-alloy, high-tensile steel side frames as well as bolsters and one-wear wrought-steel wheels. As compared with some still earlier 50-ton box cars of conventional riveted steel construction with relatively heavy trucks, the Class B-24 car saves up to 9,000 lb. of dead weight.

Comparative Dimensions and Weights of Two Union Pacific 50-Ton Box Cars

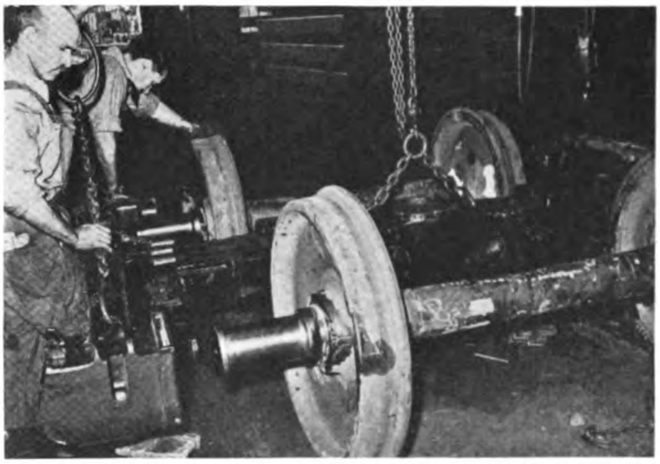
Class of car	B-19	B-24
Year built	1936	1939
Structural material	O. H. steel (riveted)	H. T. steel (riveted and welded)*
Inside length, ft.-in.	40 - 6	40 - 6
Inside width, ft.-in.	9 - 2	9 - 2
Inside height, ft.-in.	10 - 0	10 - 0
Cubic capacity, cu. ft.	3,730	3,730
Lightweight of car, lb.	45,100	39,700
Load limit (revenue load)	123,900	129,300
Ratio pay load to gross load	0.733	0.765
Detail weights, lb.:		
Car body (incl. underframe)	30,000	26,520
Trucks †	15,000	13,180
Underframe	8,550	7,518

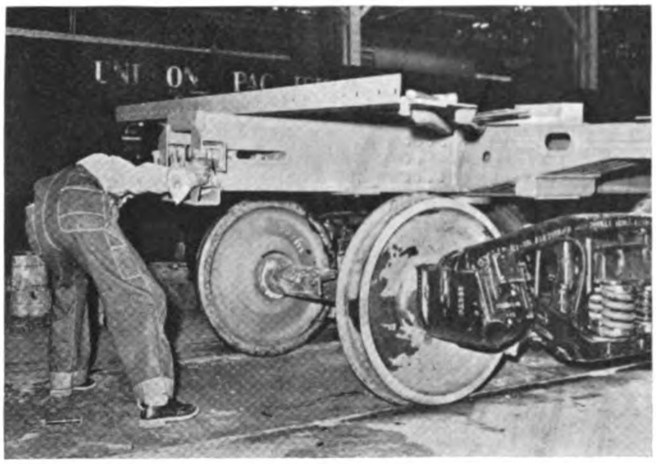
* Car body mostly riveted—underframe welded.
† Both types of trucks are spring plankless with H. T. steel bolsters. The B-19 has Grade-B side frames and cast-iron wheels. The B-24 has H. T. steel side frames and one-wear steel wheels.

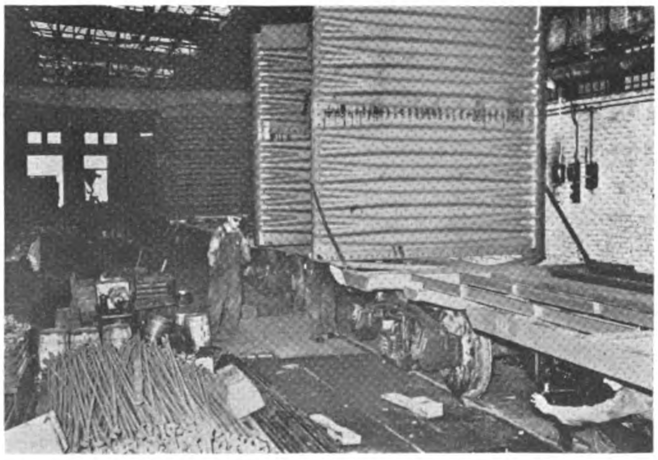
Principal Features of the Car Design

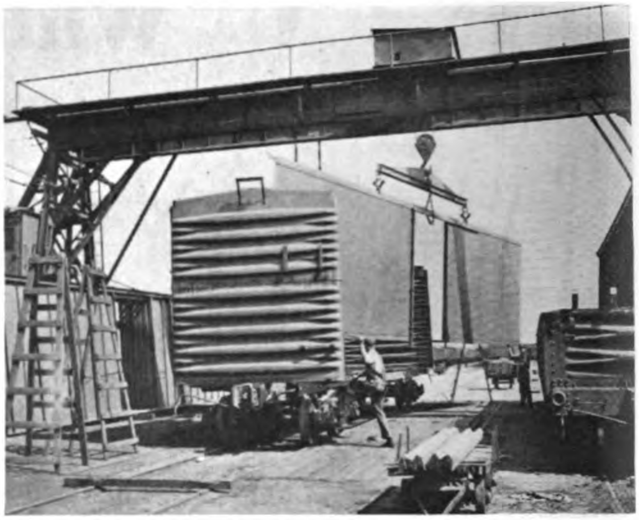
The trucks for the Union Pacific Class B-24 lightweight box car are double-truss spring plankless type with 5½-in. by 10-in. journals. The side frames and bolsters are made of high-tensile cast steel. Trucks are equipped with plain hard cast-iron side bearing; Creco No. 3 brake beams, flexible supports, sliding chairs and bottom rod guards; Schaefer brake hangers, wear plates and lightweight bottom rods. The trucks are equipped with bolster snubber springs and have one-wear wrought-steel wheels.

The underframes, fabricated by the Mt. Vernon Car Company, Mt. Vernon, Ill., are of welded construction with A. A. R. Z-section center sills of copper-bearing







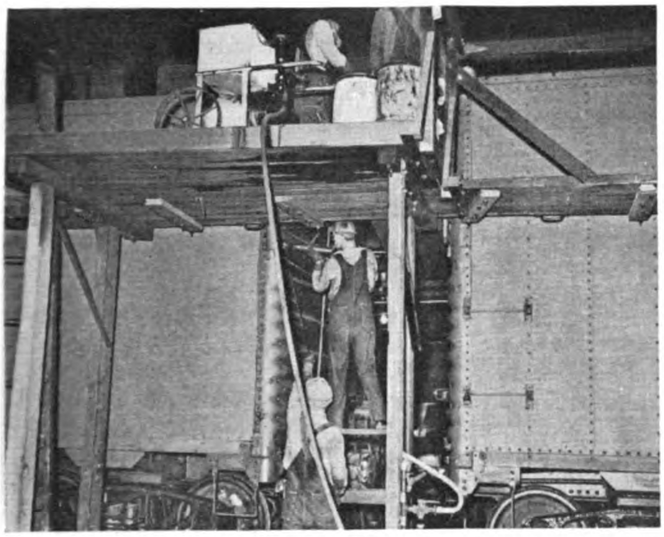


Left, top to bottom: Assembling a truck; setting an underframe on the trucks; applying a car end with the shop crane; putting up the air-brake equipment—Above: Jig used with a gantry crane for handling a side panel

open-hearth steel; all other parts of the underframe are of low-alloy high-tensile steel. Four floor supports are provided instead of the conventional two, in order to give stronger floor support for concentrated loads. The floor supports extend from bolster to bolster. The coupler striker and carrier are built-up welded constuction; front draft lugs are forged steel, welded to the center sill. The combined center filler and rear draft lugs are high-tensile cast steel, riveted to the underframe. Center plates are made of forged steel, riveted and welded to the underframe.

The superstructure is of riveted construction, using both copper-bearing open-hearth steel and low-alloy high-tensile steel and is similar to the A. A. R. design with slight modifications. Low-alloy high-tensile steel is used for the side sills, side posts, door posts, W-section corner posts and Dreadnaught steel ends. The intermediate side sheets are .067 in. thick, made of low-alloy high-tensile steel. The side plate is a Yoder Mill section of copper-bearing open-hearth steel. A departure from the conventional construction is the use of end side sheets of greater thickness than the intermediate side sheets and the addition of furring-post angles which extend from the side sill to side plate. The end side sheets are .10 in. copper-bearing O. H. steel and furring-

Below: Applying the Douglas fir plywood ceiling panels; joints are broken with batten strips



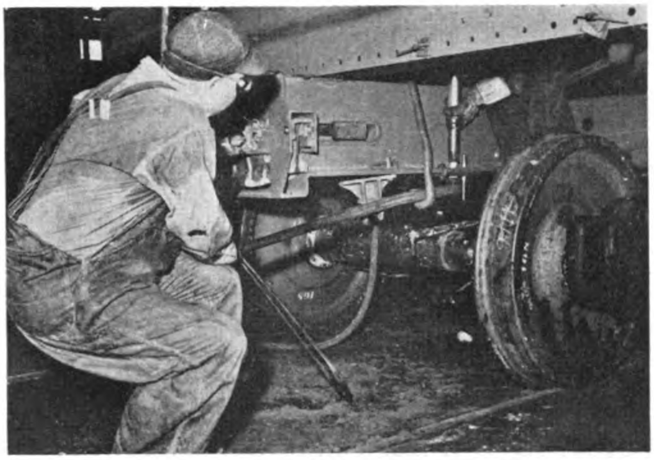
Above: Riveting the car ends

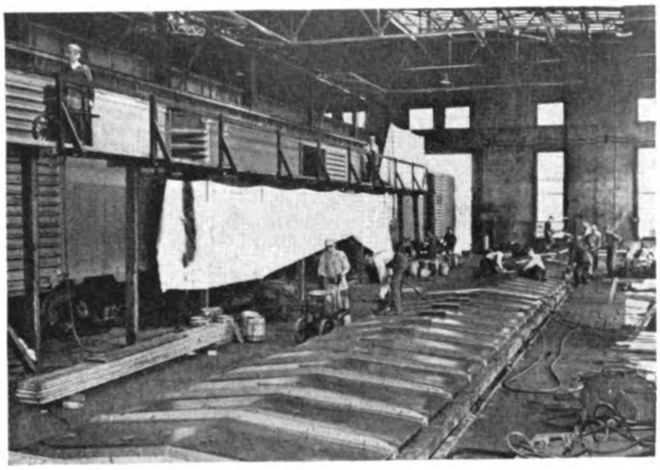
post connections are 2½-in. by 2-in. by ⅛-in. rolled angles. The corrugated ends have large-radius corners which, with the W-section corner-post construction, heavier end side sheets and furring post angles, materially stiffen the car body with little added weight to the car.

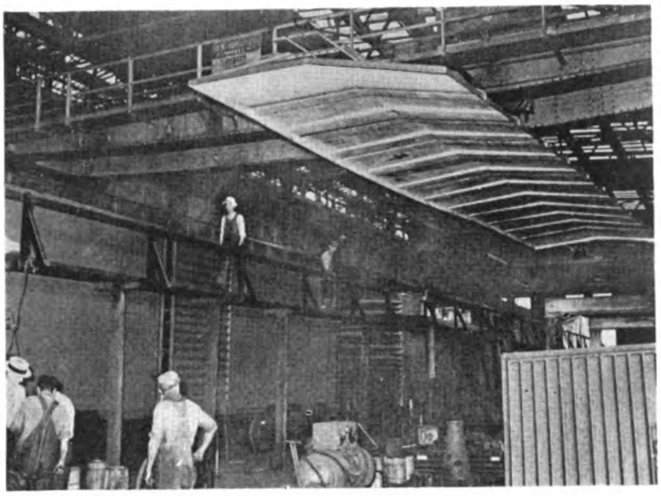
The doors are a corrugated intermediate-weight design, furnished by the Youngstown Steel Door Company with Camel lightweight roller-lift fixtures. Roofs are Murphy improved solid steel, made of low-alloy high-tensile steel.

The cars are equipped with Type-E high-tensile cast-steel couplers, bottom operated by Imperial rotary coupler release rigging. The cars are also equipped with the Union Metal Products Company's coupler centering device, Type AB brakes and various makes of vertical-wheel high-power hand brakes. All hand brakes are provided with oil holes for oiling the internal working parts. Lightweight high-tensile cast-steel vertical coupler yokes are used with various makes of certified draft gears. All small forgings are manufactured in the railroad company's shops.

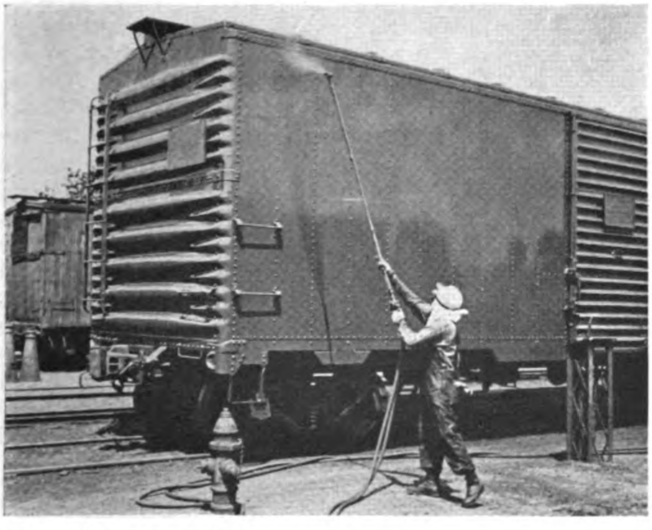
The car interiors are completely lined with wood. The floor is 1¾ in. thick, with Philippine mahogany used in







Right, top to bottom: Driving carrier iron rivets; assembling car roofs in a special jig; completed roof being lifted by the shop crane and being applied to one of the cars; jacking the floor boards tight preparatory to applying the keyboard—Below: Spray painting one of the 50-ton box cars



the doorways and Douglas fir in the balance of the car. The sides and ends are lined with $2\frac{5}{32}$-in. Douglas fir. The ceiling is lined with $\frac{5}{16}$-in. Douglas fir plywood panels which are secured to the roof at the roof joints by metal strips. Plywood strips cover all roof joints and side plates so that the only exposed metal surfaces on the inside of the car are the doors.

Progressive System Used in Building Cars

The cars are assembled, using the progressive spot system, whereby specialized gangs supplied with necessary tools and materials, perform all major operations at specified positions as the cars advance along the assembly lines. Trucks are assembled under a small gantry crane at one end of the erecting shop, special lifting hooks and chains being designed for most efficient use with this particular type of truck. A hand-operated chain hoist is used to support the bolster, and two quick-acting air hoists save time in lifting the side frames.

In the next position, the underframe is removed from the flat car on which it is shipped from the builder and placed with the shop crane on a jig in which the draft gears and yokes are previously assembled. Simply dropping the underframe thus slips the draft gears and yokes into place without an extra operation. These parts are temporarily keyed in position while the underframe is placed on the trucks, after which the previously assembled steel ends are put in place with the shop crane. The couplers are also placed by the crane with a special lifting hook, which saves time and is much safer than the method formerly used.

The air cylinder, reservoir and AB valve are next applied, and then the air-brake piping which is extra-strong steel. Pipe sections are cut and bent in advance in the pipe shop, and are blown out with compressed air to assure the elimination of all loose dirt and scale. At this position, the coupler centering device is applied and hand-brake fixtures riveted.

The car then moves out of the shop under a gantry crane where each steel side is applied as a unit. The next position in the shop is devoted to fitting up and reaming, followed by riveting. The gang which rivets the steel ends, ladders, sill steps, and top and bottom corners, remains in one position between two adjacent cars where they can work to best advantage, with all tools, rivet furnace, scaffold, etc., conveniently located.

The exact number of flooring boards required is next loaded in the car and a portable scaffold is placed inside for the roof-riveting gang. While in this position, the top corner connection and push pole pockets are welded to make them weather-proof. The car roof is assembled in a jig on the shop floor and applied to the car, using the shop crane and a long beam with seven points of chain-and-hook connection to the running-board saddles, which enable the roof to be lifted without springing it out of alinement. The floor boards are spread out and the floor laid, being jacked tight and a key-board applied. Holes are bored for the bolts from underneath the car, after which the bolts are applied and nuts tightened from underneath by means of pneumatic wrenches. The bottom door tracks are put in place and welded, the doors applied and fitted.

The next operation is applying the side furring posts and end fillers to which the inside lining is toenailed. Application is then made of the side lining, end lining, plywood ceiling, side and end facia, after which the car is cleaned preparatory to adjusting the side-bearing clearance, testing air brakes, painting and stenciling.

The car is moved outside the shop and given two coats of red synthetic freight-car paint by the spray method. The galvanized roof sheets are primed with a light coat of Stibloy to give a good bonding surface, after which two coats of paint are applied. All steel, as received at the shop, is protected with one coat of chromate base primer. On the interior steel floor supports and side and end walls for a distance of two feet above the floor, an additional coat of car cement is applied to give further protection to both the steel and the wood against moisture.

The Class B-24 box cars are put through the shop on a production basis, individual gangs being changed in size whenever necessary to assure completion of the work at each position at approximately the same time, so that the entire string of cars on each track can be moved at once. The combined average production at the three shops engaged in this car-building program is about 20 cars a day.

Building Up

The Car Inspector*

By Fred Peronto

IN times past we know that very little attempt at any kind of a system was ever made to train men for car inspectors' positions, and at some of the larger terminals, particularly in the metropolitan areas where mostly foreign-born carmen were employed, just about anyone who could read and write eventually landed a car inspector's job regardless of how well qualified he happened to be for the position. The limited field from which to choose, of course, made this unavoidable in most cases.

Today, it is somewhat different, for now we have a much larger percentage of carmen on our railroads who can read and write very well and, therefore, with a greater field from which to choose, there is less reason to have unqualified men on the job. And in many cases where we do have them, it is perhaps due to our indifference toward adopting some sort of a system for training and selecting men for the position.

In building up a car inspector we believe that, regardless of the kind of system employed, it should provide him with the proper background and training for developing the following two very important qualities: (1) The ability to detect all possible defects on cars in train yards and in trains; (2) the capacity for using good judgment in deciding whether to shop the loaded car or allow it to go forward, where defects are noted.

* Abstract of a paper presented at the May meeting of the Car Foremen's Association of Chicago. The author is A. A. R. inspector, Chicago & North Western.

There are other necessary qualities to be desired in a car inspector, of course, but none are so important, and if he lacks these two he has no foundation for developing into a successful man.

The ability to detect all possible defects on cars is something that the individual can develop through constant study of weaknesses in various types of equipment. The number of ways by which we can help him in this development, however, are very limited. Outside of coaching him, all that we can in the matter of known weaknesses in various items on certain equipment, perhaps the greatest aid that we have to offer is the encouragement we give in commending him from time to time for locating a particularly dangerous defect that was not easy to find.

But when it comes to a car inspector trying to develop his capacity for using good judgment in shopping cars, there are a number of outside influences to be considered. Here is where his superiors can either be of great help to him or else act as a retarding influence that will keep him constantly confused. Perhaps the two greatest influences on a man's good judgment in shopping cars are the matters of discipline and the kind of a boss that he happens to have.

Fair Discipline and a Good Boss Needed

The relative merits of the various systems of discipline in effect on railroads will not be discussed here, but we will say, in passing, that some form of discipline for actual failure in the performance of our duty is necessary. We do not believe, however, that it should be so severe as to haunt the very lives of our conscientious men. No man can do his work properly, and especially not when it comes to rendering decisions of importance as to the safe movement of a car, with haunting fear of a severe sword of discipline forever hanging over his head. Discipline on a fair basis is neither resented nor feared by any man and we actually believe that car inspectors in general perform their very best under such a system.

We assume that if the average car inspector were in a position to speak his mind freely he would ask us to give him the kind of a boss who always kept both of his feet on the ground, for there is nothing in the world that will rattle a car inspector more quickly than an excitable boss. We also suspect that one of the prayers of some of our car inspectors is for the Lord to rid them of the kind of a boss, directly in charge, who will not stand back of his verbal instructions.

When you really stop to consider, you will note that the Association of American Railroads Code of Rules has given us comparatively few items on railroad cars where definite limits for specified defects have been prescribed for shopping the car. The only really important one where it does, of course, is the item of wheels. Rule 56 tells us when we can remove air hose and Rule 66 specifies when journal bearings can be removed, but we do not have to shop the car to repair either of these items. Rule 63 sets up certain wear limits on brake beams but it also specifically mentions that these limits are not to be used for shopping cars in the train yard but rather on cars passing over the repair tracks. And on couplers only the area in the back wall of Types D and E has been covered in Rule 18; cracks in the shank and in the other parts of the head are left to the judgment of the car inspector. Certain safety-appliance items are covered by the Interstate Commerce Commission laws, as well as are tank-car regulations, but invariably most of these are not concerned with the safe operation of the car in trains.

All rules and regulations are noticeably silent, however, when it comes to condemning limits for such defects as cracks and flaws in truck sides, arch bars, truck bolsters, body bolsters, etc. Loose coupler-yoke rivets, slack drawbars and cracked or worn coupler yokes are left to the judgment of the car inspector. The rules are also silent with respect to the extent that such items as center sills, draft arms and lug castings have to be defective before the car can be shopped and repaired. And yet, the condition of all of these items which we have enumerated is just as important to the safe operation of the car as are the items of wheels and certain safety-appliance defects.

Most Dangerous Defects Left to Car Inspector's Judgment

The difference, however, is that we have been provided with a gage and a set of regulations to handle the one kind, while we have to use our good judgment, such as it is, to cope with the others. The point that we wish to make is that by far the majority of the so-called dangerous defects on the cars are left to the judgment of the car inspector and that is why we wish to emphasize again the fact that it is so important to the well-being of a railroad to have a force of car inspectors who are really capable of exercising good judgment at all times. We know that even in the consideration of wheel defects, many a capable car inspector has been very successful in using his technical knowledge and his good judgment rather than close application of the wheel gage. And on the other hand, we have all observed other men whom we could perhaps term not so successful from a railroad standpoint, who insist on substituting their wheel gage for their better judgment at all times, simply because they have been provided with such an instrument.

One very common failing in our inspection methods a few years ago was to gage the type of inspection on a car according to the importance of the commodity that it carried. If it were a load of livestock or a load of perishable fruit we looked the car over very carefully, indeed, in order that no kind of a defect would get by us. If it happened to be a load of company coal why we just gave the car a casual sort of inspection, and empty cars in general rated about the same kind of a job. In times past I have actually heard inspectors remark when told that there was a train of empty stock cars on hand to be inspected—"Well, it doesn't make much difference

whether these cars get inspected or not. We'll get 'em in a hurry; they're only empty stock cars."

It is still true that, if we miss a defect on an empty car and it has to be set out of a train enroute, the situation is not nearly so serious as it would be were a loaded car involved. However, we have learned that it is also a serious situation where we indifferently overlook defects on empty equipment moving forward to outside points for loading. For when these cars are eventually loaded the existing defects are sure to be found and serious delay to the load may be the result. Therefore, we should all realize that it is mighty important for inspectors to make just as good, or even better, an inspection of empty equipment as they do on loaded cars in order that all defective empties may be switched out and repaired before they are loaded. That is the time to do the job; not after they have been loaded. While we have made much improvement in this respect during the past few years, there is still a lot more that can and ought to be done.

Car Inspectors' Duties Compared, Past and Present

The question has sometimes been raised as to whether or not a car inspector's position is not somewhat easier today than it was twenty years ago and no doubt some very convincing arguments could be presented on either side of the question.

We might state, for example, that there are less weaknesses in the equipment as it exists today than there ever were. When all of our cars had arch-bar trucks the car inspector had to spend a lot of time down on his knees scraping off rusty scale and examining the bends in the arch bars for possible fractures. He had to watch closely for badly worn journal-box and column bolts, for nuts missing on the same items, for sprung arch bars, broken brake-hanger castings and for numerous failures on swing-type truck bolsters and other earlier types of built-up bolsters.

And when we handled mostly wooden underframe equipment he always had to be on the look-out for split center sills, broken end sills, split and broken draft timbers, broken draft bolts, broken lug bolts, broken body truss rods, defective queen posts and a lot of other underframe items on the car. Rule 44 combinations, too, were very numerous on the old wooden under-frame equipment and inspectors at interchange points used to perform a lot of acrobatic stunts crawling around under the cars to detect possible sill failures.

Getting up a little higher on the car, we used to find a lot of side doors swinging out of the guides or off the track or bulged out so badly that they were about ready to drop off. Running-board saddles were secured only by screws and they were continually becoming loose, letting the whole running board swing loose out over the side of the car. Numerous car ends were found either broken or forced out, which invariably caused insufficient safety appliance clearances or else outright defective safety appliance.

And didn't we have fun during the grain season! It was quite a job to keep the body of a wooden car boxed up tightly at all times in the good old days and so we used to have a lot of grain leaks. They were the headache of every car inspector who ever handled cars during the old grain seasons. He didn't exactly like to put a bad-order card on every car so he spent a lot of time and energy coopering up hundreds of leaks with burlap, paper, scrap lumber or what have you.

Periodic journal-box repacking and attention was not followed out very closely twenty years ago and so the inspector always had a lot of hot boxes to contend with. There were also a lot more cars with defective air brakes resulting in a lot more flat wheels. Car wheels, too, were not so well made and, therefore, developed more failures that had to be watched very closely.

And so we have the picture of a car inspector of twenty years ago as being a pretty busy man; and on top of all of this, he necessarily had to write out a lot of bad-order cards and enter a lot of bad-order records in his books. During winter weather in colder climates this outside book work was anything but a pleasant task.

And what is the picture today? Perhaps a real old-timer could explain the situation much better than I can for he has worked faithfully along with the change from the old to the new and he fully appreciates all that has taken place along the way.

We might begin by saying that with the passing of the arch bar our present type of trucks under our cars develop comparatively few defects. Solid truck sides and solid truck bolsters develop but few fractures that are really dangerous. In some trucks, spring planks have been eliminated entirely, leaving one less item to be watched. Rules permit the renewal of many brake-rigging items for worn conditions, where they did not in the past, and consequently these items are being maintained in much better shape under our present cars. This, too, relieves the car inspector of closely examining a lot less of these badly worn items and rendering his decision thereon. A lot more cars of today carry auxiliary brake-beam and bottom-rod supports to protect brake-rigging failures and it is not nearly so common a sight around a railroad yard as it used to be to see car inspectors pulling a lot of mangled brake rigging items out from under a car.

And with our present steel-underframe equipment, how many cars do we find with Rule 44 combinations? Center sills, draft sills, or end sills seldom fail all at once, and not so many fractures develop, either, and those that do are ordinarily not so hard to find. We all know that the underframes on our present cars do not have so many weak points to be watched.

Passing from the underframe to the body of our present cars, we find either an all-steel or else a reinforced side door that does not bulge out easily, and is seldom in such shape that it can be forced out. And with well secured door tracks and an improved type of door fixtures, doors seldom get off the track or out of the guides or become lost off the car. Running-board saddles and running boards are now mostly secured with bolts so we have less running boards to become loose and sideswipe passing trains. Side fascias, too, what few are left, are mainly secured with bolts, and with most of our cars carrying metal roofs, there are fewer wooden-roof cars to be watched that develop loose roof boards, another very common sideswiping menace in the old days.

And so it naturally follows that the car inspector of today applies a lot less bad-order cards on cars and, therefore, in those same cold climates that we mentioned before he probably has a much better chance of keeping his hands warm.

In making the above comparisons of the old with the new we do not wish to detract in any way the credit that is justly due our present force of men. The car inspector of today looks over his cars just as closely as he ever did—in fact, he looks even more closely—but taken as a whole the number of existing defects and weaknesses to be found on our present cars has dwindled down considerably. Therefore, it naturally follows that less time is required for actual inspection of the car. And, by the same token, inspectors do not find it necessary to perform so many light repair jobs to keep the cars moving.

Modern High Speeds Introduce Inspection Problems

High speed, however, is one operating condition with which the present car inspector has to contend that he did not have in the past. Any failure under present operating speed would be likely to cause more damage than it would have in the past with slower trains and, therefore, he has to be more careful in his inspection. Delays, too, especially where due to such common failures as hot boxes and the like, are not tolerated in the same manner as they were in the past and, therefore, he has to do a better job of inspecting and servicing his cars in order to avoid them.

The evolution in car-building standards has taken away some of the necessity for constant inspection of many of the details of our equipment, and, along with it, perhaps, some of the prestige of that old equipment watchdog—the car inspector. However, the wise car inspector of today is proving his worth and is fighting to gain even more prestige by his efforts to render additional service on the job. And so we find him doing a better job of service-treating his journal boxes, a better job of examining his journal bearings to detect worn conditions and waste grabs, and thus he helps to cut down the hot boxes. We find him making a closer inspection of brake-rigging parts and spending all the time that the job will allow him in replacing worn and defective cotter keys and connection pins and brake-shoes and keys. And here again he eliminates the danger of many a brake-beam failure. He carefully checks his train line and his air hose items and, under the terms of the A. A. R. rules, removes defective air hose from cars before they get deteriorated to the point where they will surely blow out while in a fast train and thus cause serious trouble. In short, he is applying himself more closely to the old fundamentals of his job and at the same time seeking new details of service that will benefit his company. And just so long as enough men in our ranks are moving in this direction we need have no fear of the future of the car inspector—he'll always be an important and a welcome part of our railroad operation.

We sometimes wonder who invented that old legend about the car inspector who, when he was asked why he went around the car with a hammer and tapped the wheels, shook his head and replied that he had been doing it for thirty years because he had been told to, but didn't know why. However, we do suspect that the inspiration for the yarn came from someone watching the listless performance of some of our car inspectors in those days. The picture of a man mechanically wandering along a string of cars looking rather indifferently at parts of a car now and then used to be quite common indeed.

It is much more refreshing to observe the car inspector of today as he passes alertly along his trains in the yard, carefully opening each journal-box lid and peering in on both sides of the journal to determine the condition of the journal bearings and the packing, and eagerly watchful for other defects on the car that might cause trouble. He is armed with the knowledge for handling his job that he has gained from his own experiences, and from a careful study of the existing rules and instructions. Therefore, he knows just what to do at all times and he is confident that his job is very important insofar as the safe operation of trains is concerned.

In many instance car departments in the early days on railroads failed to gain much in the way of respect from outsiders or even from railroaders outside of their own particular department. Contacts with some of our early wheel tapping type of car inspectors may have been partly responsible for this. We hope that we have lived down that picture by this time. But we must remember that an intelligent group of willing workers, thoroughly versed in all matters pertaining to their job, is bound to command respect from everyone, including themselves.

The Car Inspector as a Railroad Representative

We should all realize that the car inspector comes in contact with others outside of his own department perhaps more frequently than any of us. He works daily with switch crews and train crews in handling his trains. Yard clerks and even yardmasters often get a lot of their detail information from him. He deals directly with the local agent in many cases where he furnishes perishable freight protection or handles seal records. In addition to this, he is often sent out to local industries to measure high and wide loads for clearances, to instruct shippers how to block an open-top load or to inspect one after it has been loaded. He goes to manufacturing plants to inspect cars just unloaded to see if they are fit for reloading. And he is even called upon to make inspection of cars at unloading platforms where lading is damaged due to the physical condition of the car. This group of men, including the outsiders whom he contacts at the industrial plants, are bound to be greatly influenced in their opinion of our department through their dealing with the car inspector. Therefore, he is indeed in a position to do his department, and even his railroad, a lot of good. If he presents a good appearance and conducts himself in a businesslike manner and is eager to be of assistance at all times and can furnish valuable information, or can intelligently answer questions with reference to his end of the railroad game, then we can truly say that we have an ambassador who is building up a lot of good will towards his department, along with his daily work. And if he fails in all of these points he does not properly represent his department.

In the foregoing remarks we have attempted to indicate the need for building up the car inspector, for his position is of great importance in the handling of all cars. Anything that can be done to further his development should not be overlooked.

Some roads broadcast questions to their inspectors periodically pertaining to current rules and regulations. In seeking out the information to answer these questions the men are likely to become quite well versed on all such references. Another practice which we have noted is to broadcast useful information on the handling of important matters quite frequently by means of circular letters. Other railroads see to it that education and training is imparted to their inspectors first-hand by their immediate supervisors and by their field men. All of these methods are helpful to the inspector, but they are of little use unless the individual, himself, is willing to accept in the proper spirit the chances that are offered for his development. As a whole, however, it is most gratifying to note the eagerness with which most inspectors will accept first-hand training and information on how to handle their job, once they are satisfied that a sincere and honest effort is being made to help them.

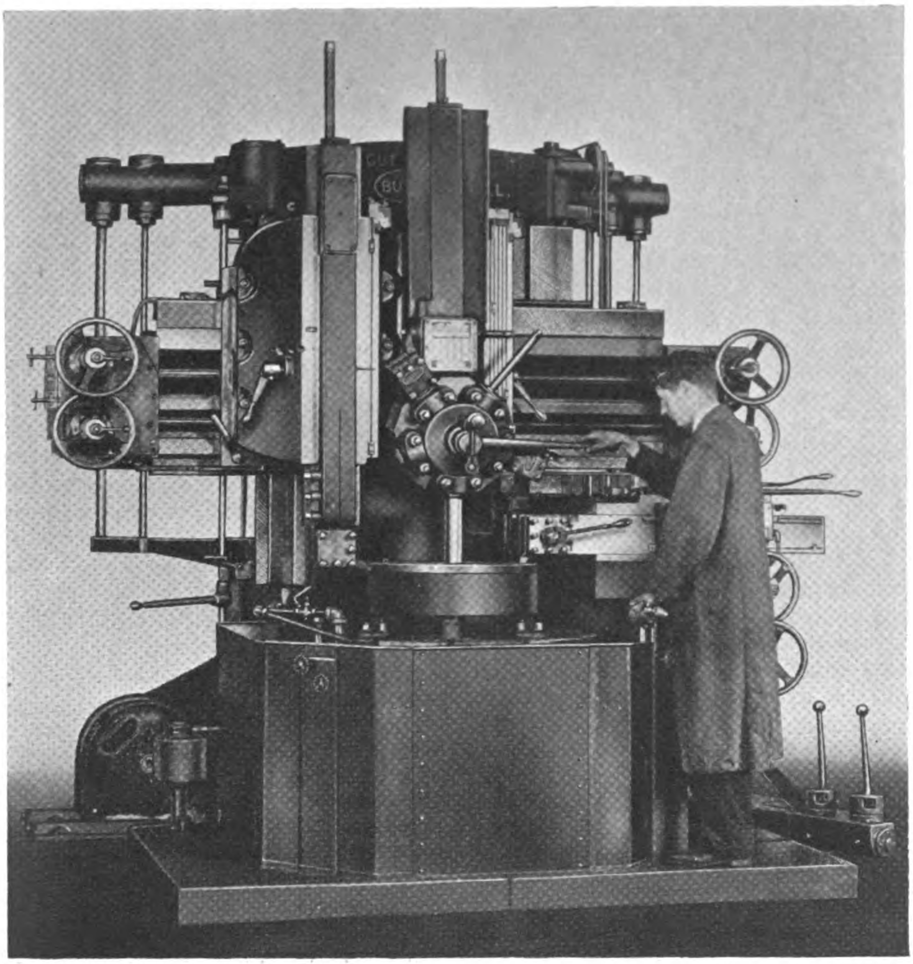
Occasionally a man may be found who seems to have learned the knack of developing himself without much outside help. He is usually a good student of all matters pertaining to his work and at the same time a keen observer. Such men usually turn out to be good car inspectors. Since none of us have all men of this calibre in our organization, however, there will always be need for training our men and those of us who practice this diligently are bound to be rewarded in the end by a first-class force of car inspectors who are indeed a credit to the railroad.

NEW SHOP TOOLS AND EQUIPMENT

Vertical Turret Lathe

The Cut Master vertical turret lathe is one of the latest achievements of the Bullard Company, Bridgeport, Conn. This new line of machines is built in 30-, 36-, 42-, 54-, and 64-in. table sizes. They are designed with a wide range of feeds and speeds and the ability to stand up under high-horsepower loads in order to utilize to the utmost the capabilities of modern carbide and other cutting tools. On a test with this machine one set of single tungsten-carbide tools removed 220 cu. in. of cast iron per minute.

The 30-in. and 36-in. machines are designed for two heads, a main turret head and a side head, while the 42-in., 54-in. and 64-in. machines carry three heads, a left-hand main ram head, a right-hand main turret head, and the side head. However, any choice of heads are available to meet individual requirements. All the heads and functions of the machine are protected by interlocking and limit switches so that it is almost an impossibility to damage the machine through forgetfulness or careless handling. Either rail head may be swivelled 30 deg. either side of the vertical for machining angular surfaces and the heads can also be fed horizontally and their respective rams fed vertically at the same time for machining any angles up to 45 deg. Further, if the main heads are set at angles varying up to 30 deg. off the vertical center, angles ranging up to 60 deg. may be produced. The two main heads have screw feed, both horizontal and vertical, which assures extreme accuracy, smoothness of movement, and a fine finish for the work in process.



The Bullard Cut Master vertical turret lathe

The traverse and feed control are combined in one lever in the center of each handwheel, one lever for the turret slide and another for the saddle movements and this arrangement has simplified these operating functions. With this design there is a natural interlock which prevents the feed and the traverse from being engaged at the same time. However, feed of the slides does not prevent rapid traverse of the saddles or vice versa. The power traverse control is sensitive in action and produces rapid, individual, and simultaneous action for vertical or horizontal movement of both main saddles and rams as well as the side head and its ram. Each head has its own feed mechanism which functions irrespective of the others and feed changes are quickly made without stopping the machine or removing the heads from the work. There are 16 feeds and 20 speeds, all in geometric ratio.

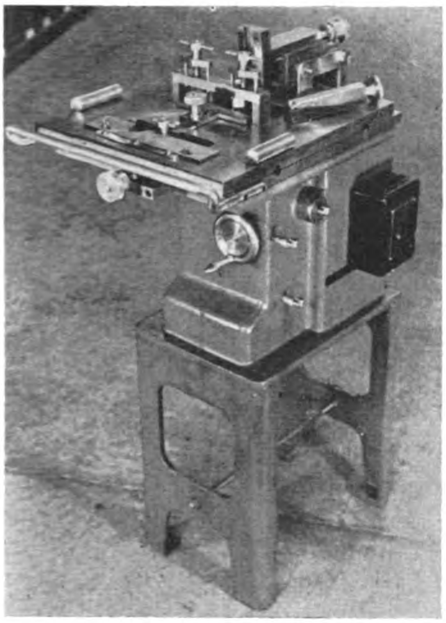
Electric stops are furnished for feeds of all the heads in any direction and they provide a feed stop-off when approaching finished dimensions. The moving members are equipped with fixed switches which contact the adjustable trip dogs at any desired setting. This action closes the circuit, thereby reacting on thrustors which, in turn, disengage the feed. On the turret head there is a selector bar which permits the use of separate trip dogs for each station of the turret. As the turret is indexed, the selector bar moves to each respective position. Trip dogs are easily adjusted, and when set for their respective dimensions they assist in the duplication of these dimensions.

It is possible to operate these machines at the higher speeds because of the large Timken-bearing spindle mountings. Anti-friction bearings at other points and the positive-pressure filtered lubrication throughout the machine assure long life with a minimum maintenance cost even under the heavy cutting or the higher speeds to which these machines can be subjected. Chucks of a new design minimize the friction within the mechanism thereby providing maximum jaw pressure with minimum turning effort of the wrench. They may be had in a three-jaw universal or four-jaw independent type having conventional T-slots.

The 30-in. and 36-in. machines have 30-hp. motors while the larger machines have 40-hp. motors. The motor drive may be either floor mounted or side-bracket mounted for V-belt drive.

Contour Grinder for Tread-Turning Tools

For many years the turning tools for locomotive tires and car wheels produced by the Gorham Tool Company, Detroit, Mich., have been ground on special contour grinders as a final manufacturing operation. These grinders have made pos-



Gorham contour grinder for locomotive tire and car-wheel turning tools

sible the economical production of ground form tools that have extremely accurate contours and the correct clearances for cutting. After many requests from customers for equipment to resharpen these tools in their own shops, this company is offering a simplified machine that permits the easy sharpening of contour turning tools in wheel shops without the need for a skilled grinder operator or expensive equipment.

The machine consists of a solid base enclosing a motor and a vertical grinding spindle. The spindle carries a chuck at the upper end in which a mounted grinding wheel is held in working relation to a turning tool clamped to the work table. The work table is given free motion in any direction in a horizontal plane by rolling on steel balls running in raceways at right angles to each other between the work plate and the intermediate plate and between the intermediate plate and the base plate. The path of the work plate is controlled by maintaining contact between a gage of the desired contour and a revolving cylindrical follower. The depth of the grinding cut is adjusted by means of a hand wheel at the front of the machine which changes the relation of the follower to the grinding wheel and permits the operator to regulate the stock removal within very close limits. A wheel-dressing attachment is built into the machine and a gaging device is furnished which locates correctly the spindle height for the varying tool heights.

The motor for driving the spindle, balanced especially for this application, delivers $\frac{1}{4}$ hp. and is available in any standard a.c. or d.c. voltage. The spindle is driven by a single V-belt running in three step cones to provide a range of spindle speeds for roughing and finishing. A special Parker ball-bearing spindle is used with vertical adjustments made by rotating a hand wheel on the side of the machine base. The motor and spindle need no adjustment or care other than the specified lubrication.

The most unusual feature of this grinder is the use of a conical grinding wheel mounted on a straight steel shank which, in operation, is clamped in a chuck seating in a taper hole in the top end of the spindle. The manufacturer recommends the use of a 12-deg. included angle on the wheel which gives a 6-deg. clearance down from the contour on the cutting edge of the turning tool. Although the dressing equipment is regularly furnished to dress for a 6-deg. clearance, it can be altered to suit individual preferences. The contour gages are furnished as standard equipment, one for the 1-in. A. A. R. tread contour and one for the $1\frac{1}{8}$-in. A. A. R. tread contour. Gages for special contours are available as extra equipment.

The operation of the machine is very simple and does not require skill or training. The operator dresses the wheel and clamps the desired contour gage in place on the work table. Then with hand screws he clamps the tool to be sharpened in place under a bridge spanning the work table. With a gage he adjusts the spindle height to suit the tool being sharpened. The motor is then started and the entire work table is guided back and forth across the width of the tool. The operator leans against a bar fastened to the work table when extra pressure is needed. Each time the tool is fed into the wheel, the entire contour is ground back the amount of the feed until all nicks are removed and a perfect contour is produced on the cutting edge. Tools ground on the contour grinder not only turn perfect contours but have a regular clearance along the entire tool which gives an optimum cutting performance.

Single-Operator Electric Arc Welder

Adjustment of the single handwheel located on top of the Wilson "Hornet" welding machine permits the operator to obtain an infinite number of current settings. Directly inside the handwheel is a dial on which the ampere graduations are plainly marked and a revolving pointer indicates the current value for which the handwheel has been set by the operator. The dial markings are so accurately calibrated that meters are not required.

The single-pole control assures a current output that will not vary, resulting in a constant, uniform arc at all times. It is impossible to reverse the polarity accidentally because the electrical circuit is so

The Wilson "Hornet" electric arc-welder

designed that only a small snap switch on top of the machine will change the polarity of the machine.

The "Hornet" is a two-bearing unit with the motor rotor and the generator armature mounted on a common shaft. Adequate ventilation is furnished by propeller blades attached to the revolving shaft which draw air in at both ends of the machine and expel it downward at the center. Although shielded-arc electrodes are recommended the machine will operate with equal efficiency if bare electrodes are used.

The machine is supplied in three sizes—Frame BA 200, Frame BA 300, and Frame BA 400, rated at 200, 300 and 400 amp., respectively. This single-operator motor-generator arc welder has just been announced by the Wilson Welder & Metals Company, Inc., New York.

Steam Guns For Cleaning Work

The Oakite solution-lifting steam guns, models No. 384 and 385, will lift a cleaning solution to a working height of about 12 ft. without the use of a pressure tank, pump, or elevated solution tank and thus

Cleaning locomotive motion work with the Oakite solution-lifting model No. 385 steam gun

eliminates the need or the expense of this accessory equipment. The cleaning solution may be drawn from a pail, an open drum or other container. The model No. 384 operates from a steam supply with a pressure of 30 to 80 lb. per sq. in. while the model No. 385 requires a steam pressure of 60 or more lb. per sq. in.

The model No. 385 steam gun is shown in the illustration cleaning the motion work of a locomotive. It has a length of $7\frac{1}{2}$ ft. and weighs $13\frac{1}{4}$ lb. Seamless-steel tubing and castings of brass or aluminum are used in its construction. This steam gun has a single seamless-steel nozzle with $\frac{15}{16}$ in. inside diameter as it is designed only for heavy steam-cleaning operations. The two circular rubber-covered handles are said to balance the gun perfectly when steam is flowing from the nozzle.

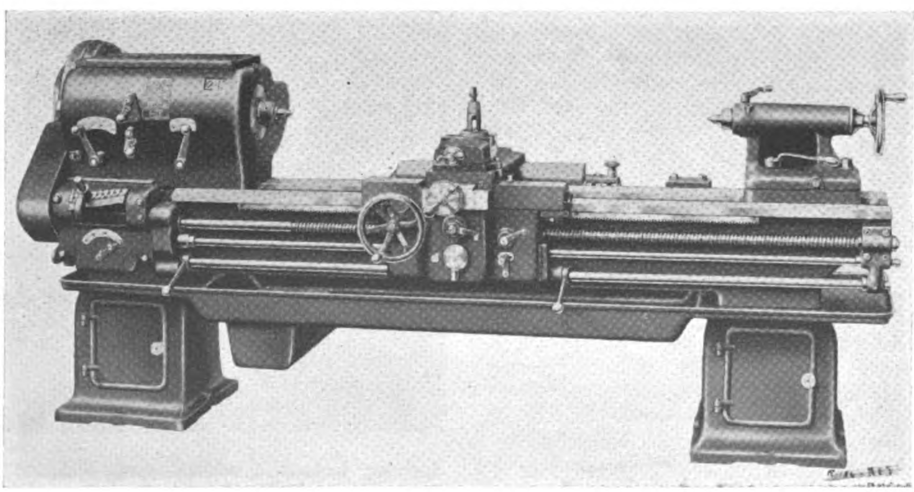
The smaller steam gun, model No. 384, has a length of $3\frac{1}{2}$ ft. and weighs $5\frac{3}{4}$ lb. It is of the same general construction as the larger gun but is equipped with two sizes of nozzles and suction orifices to provide smaller or larger quantities of cleaning solution depending upon the steam capacity available. The handle of this gun is constructed with hardwood spindles mounted on aluminum spacers and held by strong clamps in order to keep the handle air-cooled.

Both models are equipped with solution valves and steam valves and a strainer for the solution hose. The larger model was developed for the cleaning operations in connection with the maintenance and repair of locomotives and rolling stock, while the smaller model is suitable for cleaning floors, freight-car interiors, and small equipment and parts. The steam guns are made by Oakite Products, Inc., New York.

Heavy-Duty Lathes Have Speed Selector

The LeBlond Super Regal line includes the 21-in. and 24-in. heavy-duty lathes in addition to the 13-, 15-, 17-, and 19-in. lathes and the 10-in. Regal lathe. One of the new features on all but the 21-in. and 24-in. Super Regal machine is the speed selector built into the headstock with a dial to show the cutting speed for commonly machined materials and to indicate the revolutions per minute for the proper cutting speed. Eight spindle speeds are obtained through heat-treated and hardened sliding gears. The final drive is through helical gears which give strength to the gear train and a smooth, powerful drive to the spindle.

A direct motor control or multiple-disc clutch and brake is furnished on the 21-in. and 24-in. lathes where frequent and rapid stop and start is required. A lead screw and feed rod are now built in all these lathes. A single-point adjustment is of such a design that the plates can be adjusted to as little as .003 in. which gives maximum capacity with minimum pressure on the operating lever. The lathes are made by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio.



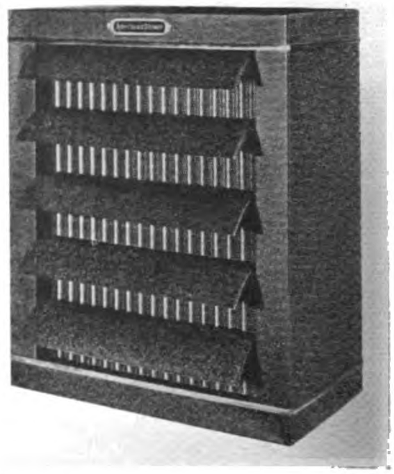
The LeBlond 21-in. Super Regal lathe

High-and Low-Velocity Unit Heaters

The Venturafin unit heaters made by the American Blower Corporation, Detroit, Mich., are available for either high or low air-velocity operation. The high-velocity heater is for use in large rooms with high ceilings which are difficult to heat. The low-velocity heaters are available for rooms requiring quiet operation. All sizes of heaters are rated for sound which makes it possible to select a heater with a sound rating for a particular sound level.

The heaters have a streamline air inlet which reduces power consumption and lowers the operating cost. The epicycloidal-propeller fan is the result of a constant endeavor to produce a wheel which would handle more air with a minimum power requirement. All the coil headers are of cast-bronze "steam metal" and are designed for a maximum steam pressure of 150 lb. per sq. in. The tubing is of extra heavy seamless copper, airfoil in shape, and designed to give the maximum heat transfer with the least resistance to air flow. The relation of the fin area to the tube area in the sheet-copper fin stock is of the proper proportion to give a maximum transfer of heat.

The logarithmic-curved louvres are die formed and individually adjustable, which permits the heated air to be deflected at any angle. All motors on these heaters are totally enclosed and are especially designed for unit-heater duty with thrust and wool-packed sleeve bearings. Standard motors are designed for operation in 125-deg. maximum air temperature and special motors are required for operation in higher temperatures. The motor bracket support is designed to present the least resistance to the flow of air.



American Blower Company's Venturafin unit heater

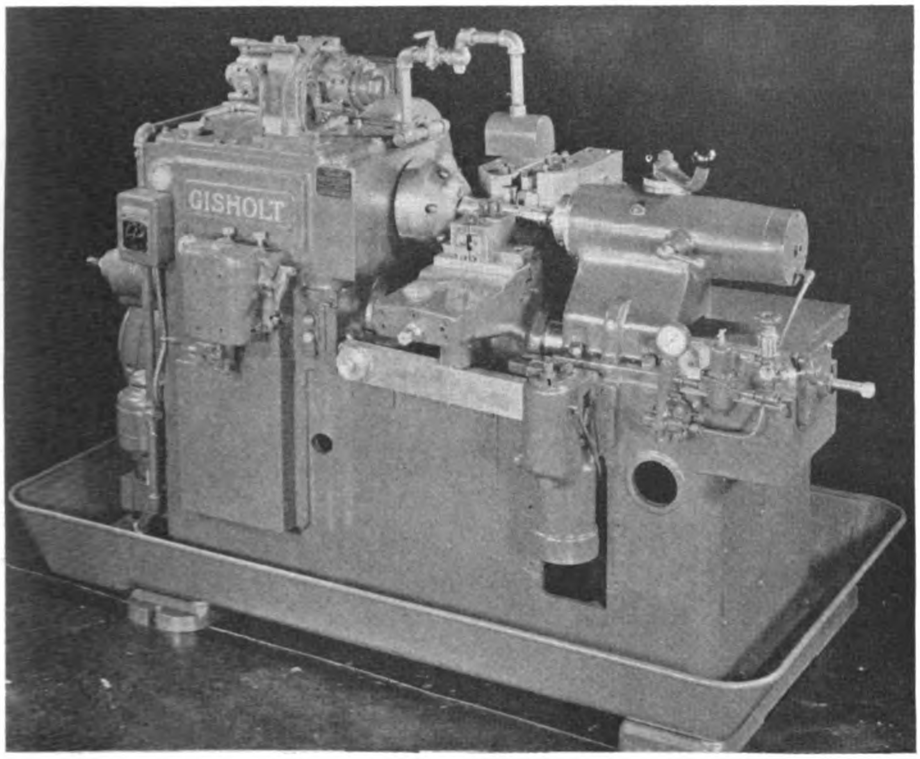
Lift-Platform Industrial Truck

The GEP-6 lift-platform truck for handling material on skids is one of the new power industrial trucks built by the Elwell-Parker Electric Company, Cleveland, Ohio. It has speeds up to 10 m.p.h. and a rated capacity of 6,000 lb. The heavy-duty industrial type four-cylinder motor develops 33 brake horsepower at a normal speed of 1,250 r.p.m. This truck has many safety features and is built under the Underwriters' Laboratory re-examination service.

The Elwell-Parker GEP-6 lift-platform truck

Hydraulic Automatic Lathe

The Gisholt No. 12 lathe is automatic in its operation. The only requirement of the operator is to place the work in the machine and pull the control lever to start the lathe. It is adaptable to a wide range of applications including between-centers, arbor, and chucking work or for jobs that must be handled in fixtures. It is ideal for high-production manufacturing, yet, due to its flexibility and the ease with which it can be changed from one job to another, it is well adapted to manufacturing a variety of parts even in small lots. The machine is made by the Gisholt Machine Company, Madison, Wis.



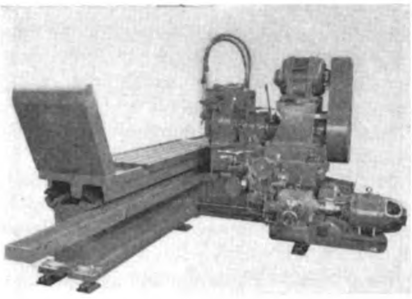
The Gisholt No. 12 hydraulic automatic lathe equipped with single-lever operated tailstock with air clamp

The adaptability of the machine to a wide range of work and the ease of change-over from job to job are due largely to the means by which the slide motion is obtained and to the unusual method of controlling the machine functions. The tool-carrying slides receive power for their motion through fluid pressure acting on the slide pistons. A large-volume gear pump furnishes the fluid power for rapidly traversing the slides and individual plunger-type pumps provide accurately metered quantities of fluid for advancing both the front and rear slides at the desired rates of feed.

Shifting the control lever upward causes the spindle to rotate and the slide to advance rapidly to the work piece. When the tools reach the proper position, the slide pistons encounter adjustable, positive, traverse stops and instantly the rapid rise in the fluid pressure is transmitted to the central control valve which automatically shifts the control lever to the feed position. The control of the feeding motion by abutment against dead stops insures precision and exact duplication of machined dimensions. At the end of the cutting stroke when the dead stop is encountered and further movement is arrested, the continued delivery from the feed pump increases the fluid pressure which automatically shifts the hydraulic control valve to the rapid-return position. The slight dwell against the stop while the pressure builds up tends to relieve the strain in the work piece and to permit the tool to cut free. During the rapid return of the slide to the starting position the spindle clutch is disengaged and the brake is applied. At the completion of the return motion the control lever is automatically shifted to the stop position.

Since the hydraulic power for actuating the control of the slide functions is transmitted by the same fluid pressure that supplies the power for the slide motion, the adjustment of traverse and feed trips is merely a matter of loosening, setting, and locking ordinary stop screws. The range of action, the location, and the direction of motion of the slides can be easily varied between wide limits. The bed and headstock of the Gisholt No. 12 automatic lathe are of one rigid nickel semi-steel casting.

Face Grinder With Centralized Control



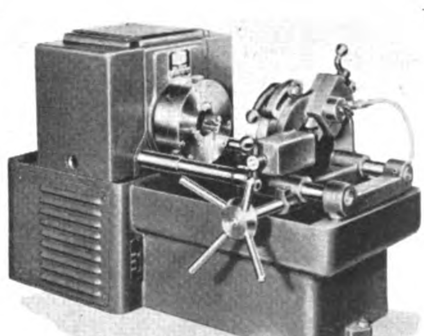
The face grinder of the Bridgeport Safety Emery Wheel Co. with centralized control

On the older design of face grinders, built by the Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn., it was necessary to go to the front of the machine in order to set the dogs for controlling the length of the carriage travel. On the improved machines all of the control levers are placed at the rear of the machine and are readily accessible to the operator.

The length of the carriage travel is controlled by the dogs on the dial at the operator's position. It is a simple matter to jump one of the regular dogs by depressing a foot treadle in order to bring the carriage out into the loading position. Any carriage speed from 5 to 90 ft. per minute is obtainable on this machine.

Pipe Machine With New Die-Head Design

The "Tom Thumb" pipe machine, known as the No. 562, has the capacity to handle all sizes of pipe from ½ in. to 2 in., inclusive, through its spindle and is also capable of driving geared die stocks up to 8-in. capacity by means of a special, universal shaft. The spindle, worm drive, and all shafts are mounted in ball bearings. It has a welded steel base and guards which give it maximum strength with minimum weight. The machine is powered by a ½-hp. Black & Decker, universal, reversible, variable-speed motor and the drive from the motor to the machine is through V-belts.



The Oster No. 562A "Tom Thumb" portable pipe machine

A new design of die-head which is integral with its carriage is used for greater rigidity and support for the high-speed threading dies. This die head tends to lengthen the life of the dies and to produce more accurate work. The front-

cutting die-head, together with the machine's "close-grip" front chuck, permits pipe lengths as short as 2½ in. to be threaded without the use of a nipple chuck. The size-setting marks are on top of the die head where they are plainly visible for easier, more accurate settings. The ways on which the head is mounted are 1¼-in. solid-steel studs supported at both ends for perfect alignment.

The "Tom Thumb" pipe machine is equipped with a built-in, cut-off attachment that is operated by a ball crank handle and opposed by a V-block steady-rest to take the thrust of the tool and prevent breakage by "hogging-in". A combination reaming and chamfering forming tool, mounted on the cut-off block, does both operations simultaneously.

An internal oiling system to the dies and cut-off tool is furnished. A flexible hose carries the oil from the pump to the intake valve in the head and the flow of oil is controlled by a two-way thumb valve conveniently located for the operator. The No. 562 machine is 23¼ in. high, 23 in. wide, 36 in. long, and has a net weight of 450 lb. The machine is made by the Oster Manufacturing Co., Cleveland, Ohio.

Tractor Crane and Auxiliary Equipment

The Krane Kar is now furnished with magnets and buckets to make it available for other than the ordinary hook work of lifting and transporting materials. The model A Krane Kar is equipped with a 20- and 25-in. magnet, and the model AX Krane Kar is available with a 20-, 25-, and 29-in. magnet. A clamshell bucket may be had with either of these models.

A gas-electric generator, mounted integral with the chassis, and a magnetic panel, master switch and automatic cable retriever with power-feed cable are the auxiliary equipment needed for magnet work. These are provided complete and ready for operation. A special quick-disconnect coupler is between the power line and the power lead of the magnet. The changeover from hook to magnet work requires only a few minutes and can be made by the regular crane operator.

The two-power-line, self-reeving clamshell bucket of ⅜-yd. capacity is intended for clean-up work and light digging. An auxiliary drum operates the holding line and the regular hook winch operates the hoisting and closing line. A tag line attachment prevents the bucket from spinning. It is possible to have the Krane Kar models, A and AX, equipped to accommodate both the bucket and the magnet.

The model A has a lifting and transporting capacity of 5,000 lb. and model AX a capacity of 10,000 lb., both at a 5-ft. radius and 3½ ft. clear from the front bumper. Power for the crane and for propelling the chassis is obtained from one gasoline engine having starting and electric-light equipment. Three worm-gear units are standard equipment for hoisting, swinging and topping, independently or simultaneously, with the maximum load on the hook. The chassis ordinarily has four speeds ahead and one reverse but can be furnished with a directional reverse-gear transmission having four speeds in both directions. This tractor crane is now better equipped

The Krane Kar handling material with the magnet

for a greater variety of material-handling applications in railroad work with the magnets and bucket in combination with the previous accessories, comprising an auxiliary gypsy winch and the standardized telescopic boom. The Krane Kar is built by the Silent Hoist Winch & Crane Co., Brooklyn, N. Y.

Oil Burner Maintains Correct Air-Oil Ratio

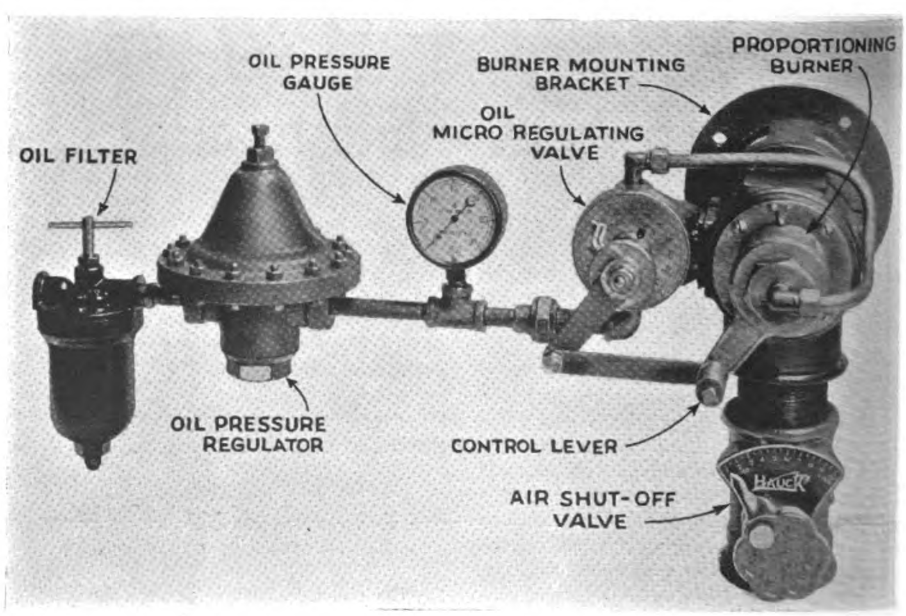
The proportioning oil burner, developed by the Hauck Manufacturing Company, Brooklyn, N. Y., automatically proportions and maintains the correct and straight-line air-oil ratio from its minimum to maximum capacity. The moving of a single lever automatically controls the oil and air supply and simultaneously adjusts both the primary and secondary air orifices in the burner. Any desired air-oil ratio, once set, is automatically maintained thereafter.

As shown in the illustration, the proportioning oil burner consists of the burner with the mounting bracket and air shut-off valve, a micro oil-regulating valve connected through linkage with the burner, and an oil-pressure gage, oil-pressure regulator and oil filter in the oil line to the burner. The air is controlled by the burner-nozzle orifices and, therefore, the maximum atomizing air pressure and constant air velocity are maintained where the oil it atomized. This eliminates reduced air pressure and velocity at the point of oil atomization when the burner is turned down.

Operating tests show that a straight-line proportioning of the air and oil flow is obtained at all dial settings of the burner and that a constant air pressure is maintained throughout the entire range of operation. This is accomplished by con-

Installation of Hauck proportioning oil burners with motor control in a normalizing furnace at the Roanoke shops of the Norfolk & Western

necting together through levers of equal radius a straight-line flow air control in the burner nozzle and a straight-line flow oil valve mounted in the burner. Advancing or retarding the oil valve with respect to the air control changes the air-oil ratio. Once these adjustments are made, then moving the operating lever increases or decreases together the flow of



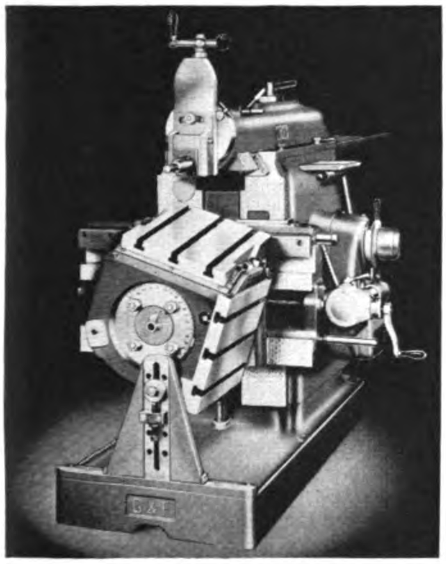
The Hauck proportioning oil burner

air and oil through the burner and maintains the set air-oil ratio over the entire range of the burner. These characteristics make the burner ideally suited to automatic control. Without any change in piping the burner can be connected to a control motor actuated by a pyrometer. A battery of burners can be regulated from one control motor and as each burner is its own individual air and oil mixer it does not affect the other burners in the group. An accompanying illustration shows an installation of these burners with one control motor regulating the burners.

The proportioning burner eliminates the necessity of relying on operators in various shifts to get the correct burner adjustment by regulating separate air and oil valves. They can be installed in any kind of furnace, oven, or kiln.

Universal Shaper For the Toolroom

The 16-in. tool-room universal shaper is one of the latest lines of tool-room and industrial shapers offered by Gould & Eberhardt, Irvington, N. J. The tool-room shapers are high-speed machines



The Gould & Eberhardt 16-in. tool-room universal shaper

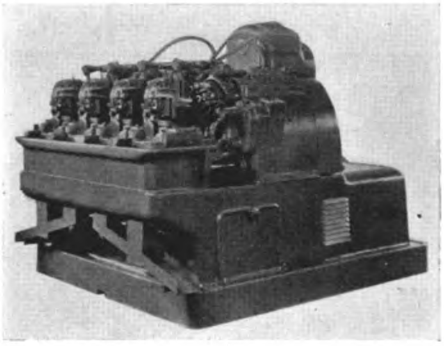
making up to 200 cutting strokes per minute and are especially adapted for tool room and die work.

The manufacturer's rapid power traverse mechanism for the work table, operative in the opposite direction to the feed set, is now regular equipment on these machines. Rapid power vertical traverse is also available on all machines for elevating and lowering the work table. All the shapers made by this company have a circulatory pressure system of lubrication which now includes automatic oiling to the entire crossrail unit and the crossfeed screw and nut. The push-button station for the motor is of the flush-mounted type with oil-proof conduits concealed within the main frame.

The shapers have retained the main double-crank gear transmission, the concentrated rail clamp for locking the crossrail, the single-control head lock, and the positive-lock front table support. The machines are available in a new two-tone color scheme of light and standard machine-tool gray.

Semi-Automatic Threading Machine

The four-spindle semi-automatic threading machine is one of the most flexible threading machines ever designed by engineers of the Landis Machine Company, Waynesboro, Pa. The machine in the photograph is set up to thread hollow-head set screws at the rate of 1,900 screws per hour with a cutting speed of less than 35 circumferential ft. per min. This slow cutting speed assures good quality and long chaser life even



Landis four-spindle semi-automatic threading machine

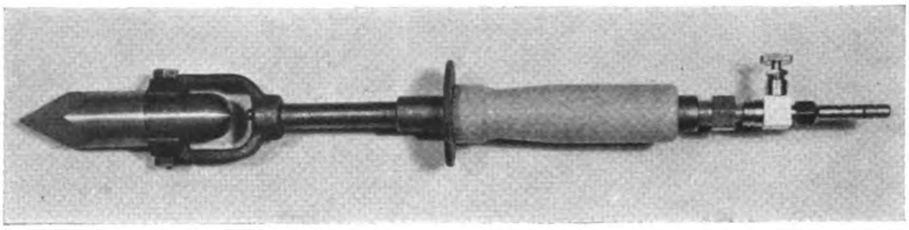
though tough alloy-steel stock is being threaded.

Indexing turrets are used on these machines when threading set screws. The turrets can be replaced easily with holding fixtures for threading bolts or special threaded parts or a gripper mechanism can be substituted for the turret or work-holding fixture if long rods or bars are to be threaded.

Air-Acetylene Soldering Iron

The Prest-O-Lite open-flame type soldering iron, recently announced by the Oxweld Railroad Service Company, Chicago, operates from a small portable B-tank of acetylene. Air for both combustion and cooling is admitted through suitable small parts in the handle which is made of metal tubing with a Bakelite hand grip and a round rubber disk which serves as a heat guard. A small valve in the pipe line just beyond the handle controls the flow of gas which, when mixed with the proper proportion of air, is ignited and burns as a small but intense flame impinging on the rounded end of the copper which is held in a U-shape fitting.

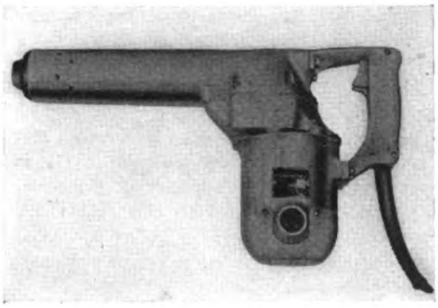
In addition to the standard soldering coppers, chisel-type and hatchet-type coppers are also available. Coppers are ample in size to retain the heat for a reasonable period of time. They can be re-forged to meet special requirements without altering the heating efficiency. It is said that the Prest-O-Lite soldering iron can be operated at a low fuel cost and is well adapted for use in both locomotive and car tin shops. In car shops, especially where there is a large amount of light sheet metal work and small soldered pipe joints in connection with the installation of air-conditioning equipment, the new tool should prove of exceptional value.



Prest-O-Lite open-flame type soldering iron

Portable Electric Hammer

Faster drilling capacity and a longer life for the moving parts are obtained in the No. 36 portable electric hammer, redesigned by the Black & Decker Mfg. Co., Towson, Md., by an increase in the motor capacity and the efficiency. This tool is a



The Black & Decker No. 36 portable electric hammer

completely self-contained unit which is powered by a universal motor and requires no transformer, rectifier, or other extra equipment.

No change has been made in the operating principle of this hammer. The action is developed by an oscillating weight and spring assembly; the weight is driven indirectly by a crank. The motor is

mounted at right angles to the barrel and operates through a train of reducing gears. The action is characterized by a definite "follow-through" stroke and produces a high efficiency. The hammer weighs 17 lb., and develops 2,300 blows per minute.

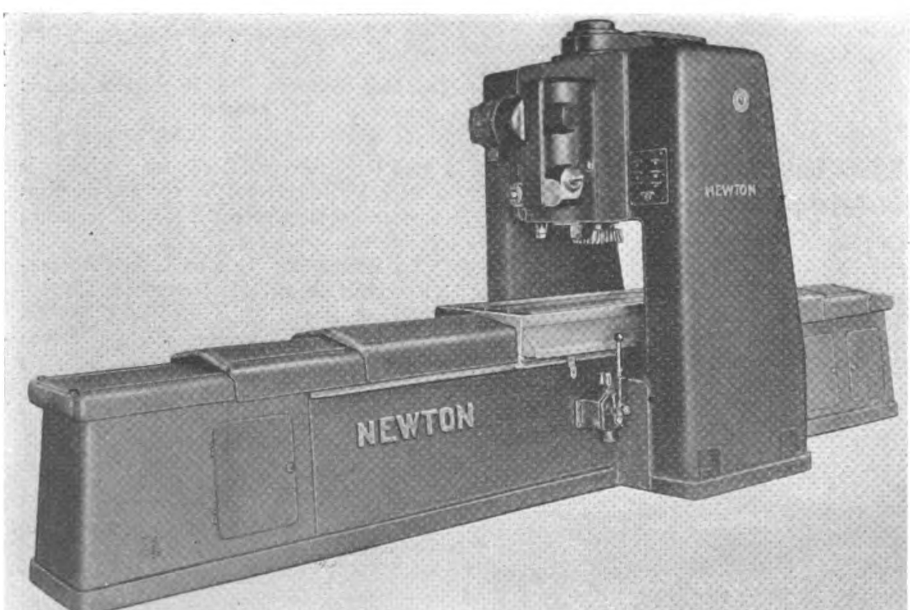
Machine Combines Milling and Shaving

The surface finish obtained with the Newton straight-line type Mill-N-Shaver is said to be smoother and more accurate than that produced by rough and finish milling, and to approach the finish that might be obtained by grinding. In operation this machine rough mills and then shaves the work on the rapid-traverse return stroke, and the cycle of operation is automatic from the manual start to the stop at the position to remove the work from the table. The cutter spindle is mounted in anti-friction bearings and is driven by an individual motor. The machine is equipped with hydraulic feed and traverse for the table.

The Mill-N-Shaver may be arranged with one or more unit milling heads and with the same number or less of shaving heads depending on the requirements of the work. The heads may be horizontal or vertical or placed at any angle to suit the surface to be finished. The shaving head is a heavy tool block in which is mounted one or more tungsten-carbide blades. The head is on a ram which has a micrometer adjustment for setting the depth of the cut. The ram automatically draws back out of the way while the work is rough milled and resumes the cutting position just before the rapid traverse of the return stroke takes place.

In operation the work is loaded and clamped in the fixture and the cycle is started manually. Automatically, the shaving head is drawn back to clear the work and the table advances in rapid traverse which changes to a feed motion as the work reaches the rough-milling cutter. At the end of the rough-milling cut the shaving head advances to the cutting position and the work is shaved as the table returns in rapid traverse to the loading position. This operation produces a smooth and accurate surface and eliminates the time required for a finish cut with a milling cutter.

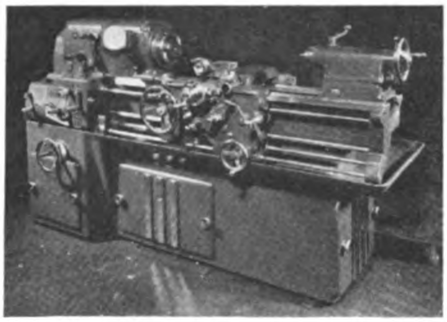
The Mill-N-Shaver is made with either a horizontal or vertical spindle. The machine is built by the Consolidated Machine Tool Corporation, Rochester, N. Y.



The Newton straight-line type Mill-N-Shaver with vertical spindle

Lathe Powered With All-Electric Drive

The Monarch 12-in. by 30-in. toolmaker's lathe is powered with a recently developed a.c., all-electric adjustable-speed drive which employs a proved principle of speed

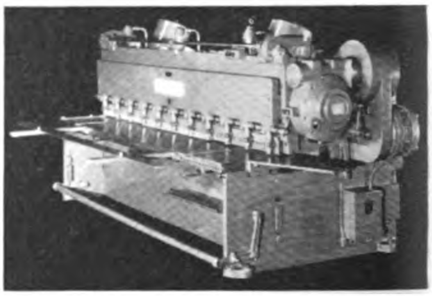


The Monarch 12-in. by 30-in. toolmaker's lathe

control heretofore confined to large drives. The 100-to-1 spindle-speed power unit is entirely self-contained and is mounted in the cabinet base. The drive is through a new type of flat belt. Two range of spindle speeds from 15 to 1,500 r.p.m. are obtained by means of a back-geared unit on the spindle. This range may be varied to suit the user's requirements. The machine is built by the Monarch Machine Tool Co., Sidney, Ohio.

All-Steel Shear with Power Back Gage

The all-steel shears of the Cincinnati Shaper Co., Cincinnati, Ohio, cut to tolerances that take a micrometer to measure and shear with this accuracy at high speed. As an example, the 1/4-in. by 12-ft. shear



The Cincinnati all-steel shear equipped with a power back gage

makes 60 strokes a minute. Hydraulic hold-downs automatically clamp any gage of metal with the same pressure and efficient use of the four-edge knives is obtained because of the fine adjustments that can be made. All standard sizes of shears from ten gage to one inch are available.

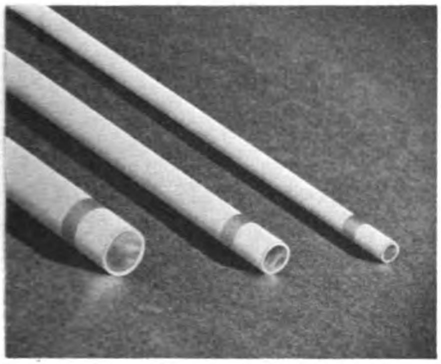
The shear illustrated is equipped with a front-controlled power back gage which is available as extra equipment on these machines. Push-button control is from the

The control and dials of the power back gage for Cincinnati all-steel shears

front of the shear conveniently located at the operator's position. As shown in one of the illustrations, the dials reading in inches and sixty-fourths of an inch are mounted above the finger-tip control. A fast forward and a fast backward speed give rapid movement to the desired position and a "spotting" button sets the gage accurately. The gage is advantageous in work requiring frequent changes of back-gage setting.

Bronze Welding Rod Is Coated with Flux

Maximum speed, convenience, and economy are required for profitable welding operations. A development of this emphasis on efficiency is the CIG Ready-Fluxed bronze, a product of the Hollup Corporation unit of Compressed Industrial Gases, Inc., Chicago. Dipping into the flux is eliminated by the use of this bronze welding rod. It is designed to keep the molten metal in a semi-plastic state to enable welders to apply it in any position with ease, and to keep it fluid enough for all brazing operations. In its manufacture the flux is extruded in a perfectly concentric coat-

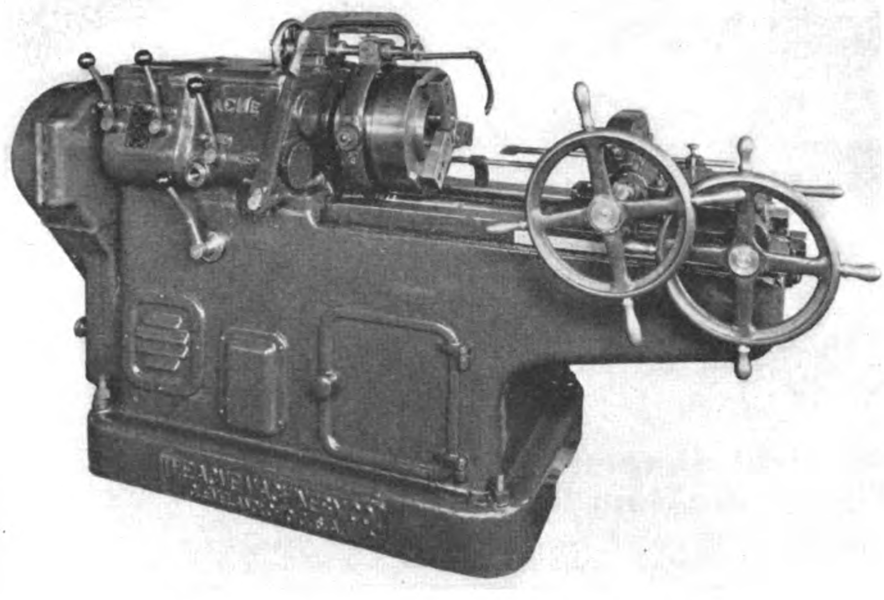


Three sizes of CIG Ready-Fluxed bronze welding rod

ing which assures a uniform fluxing throughout the entire length of the welding rod.

The CIG 400 Ready-Fluxed bronze welding rod has a tensile strength of 58,500 lb. per sq. in., an elongation of 30.1 per cent in 2 in., a hardness of 85 Brinnell, and is obtainable in 36-in. lengths. The CIG 401 Ready-Fluxed manganese-bronze welding rod has a tensile strength of 62,000 lb. per sq. in., an elongation of 27 per cent in 2 in., and a Brinnell hardness of 95. It is also available in 36-in. lengths.

Threading Machine Has Revolving Head



The Acme XR roll threading machine with 1½-in. die head

A rolled thread of any length on bar stock up to 1½ in. in diameter is produced on the Acme XR roll-threading machine just announced by the Acme Machinery Company, Cleveland, Ohio. This machine is the result of research and development work by the Acme engineers for a type of roll threading that has never been accomplished before; namely, the threading of bar stock in a range up to and including 1½-in. diameter without limit to its length. The adjustment from one diameter to another is quickly and easily made. The machine is rugged and compact and requires very little floor space.

The principle of this machine is different from the conventional roll-threading equipment in that the work is held stationary while the rugged die rolling head revolves, permitting the stock to lead through the die head and only the length of the stock limits the length of the thread that can be rolled. Holding the work stationary facilitates the handling of long, cumbersome bars which are being threaded.

The form of the thread produced by the Acme roll-threading machine is extremely accurate while the pitch diameter and the lead is held within limits of thousandths of an inch. The burnishing action of the rolls in forming the threads imparts a thread-surface smoothness that has the appearance of a ground thread. This action also imparts a slight surface hardness to the thread and strip tests show a 15 per cent increase in strength over the cut thread. The speed of thread rolling is from 15 to 50 per cent higher than thread cutting, depending on the material and the kind of thread.

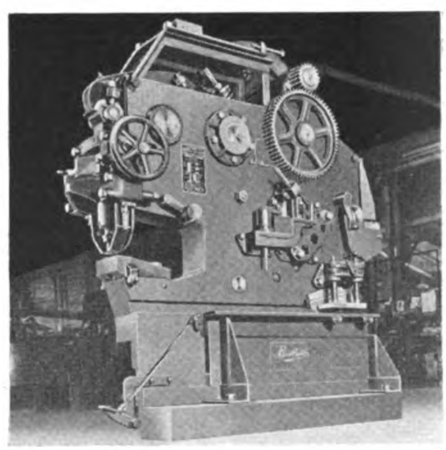
Triple threads with 1½-in. lead have been successfully rolled on stock slightly less than ¾ in. in diameter. The hardness of the stock to be threaded must be considered, but good results have been obtained in the rolling of U. S. S. 1-in., eight-pitch threads in S. A. E. steel having a hardness of 30 to 40 Rockwell. A saving of 15 per cent or more, depending upon the diameter of the bar stock, is obtained in the rolling of threads as the size of the stock is the same as the pitch diameter of the rolled thread.

In appearance the Acme XR roll-threading machine is very similar to the Acme XL thread-cutting machine. The bed is of a sturdy box-type fabricated construction with high-carbon steel ways. It has an eight-speed gear box, clutch controlled, with the gears and shafts mounted on anti-friction bearings running in oil. The work-holding carriage is actuated by a double rack and pinion.

This machine also has the exclusive Acme feature of the micrometer adjustment of the head for controlling the pitch diameters without stopping the head rotation. It has a multiple V-belt drive from a motor enclosed in the bed and friction-clutch control for starting and stopping the spindle. On single-spindle machines with work capacity up to 1½ in. diameter a five-hp. motor is furnished. The Acme XR roll-threading machine is built with single or double spindles.

IronWorker Performs Several Operations

The Buffalo No. 2½ universal Ironworker is a popular size of this machine in plants requiring a concentration of various operations in one machine. It will punch round, square or oblong holes in plates, angles, flanges and webs of channels and



The Buffalo No. 2½ universal Ironworker

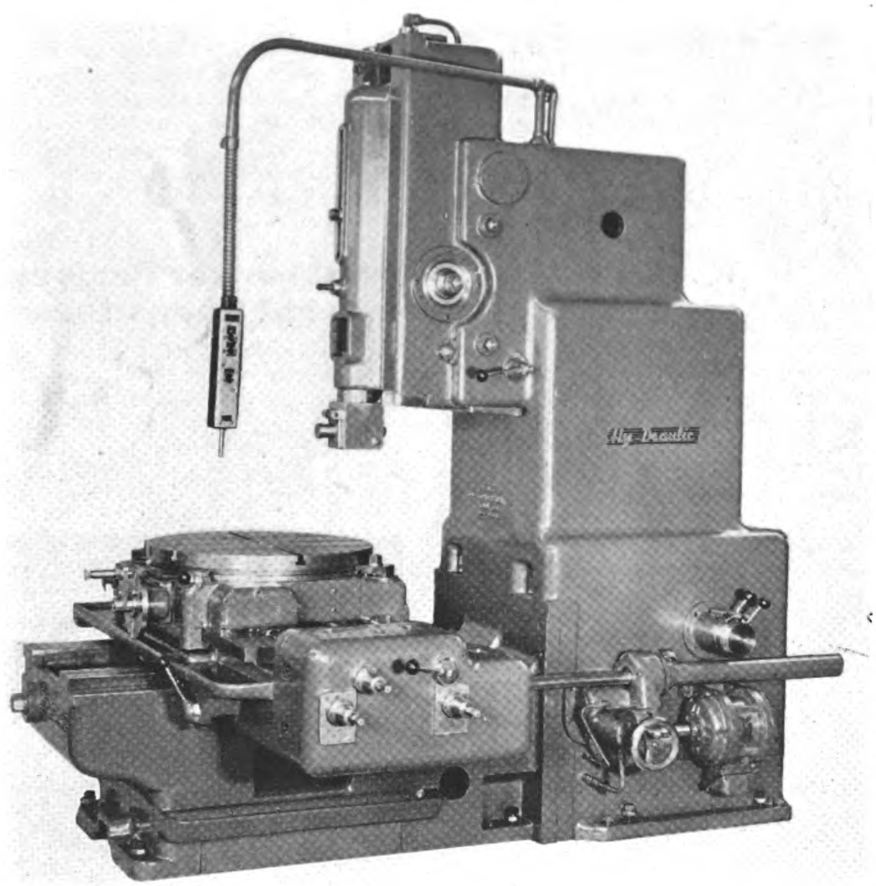
I-beams. It will shear angles either square or to right- or left-hand miters of 15, 30, or 45 deg. It will also shear round, square, and T-bars. The standard bar-cutter knives can be quickly replaced with extra knives that will shear channels and

I-beams with accuracy. In addition to these operations, the machine is designed to shear flats and split plate of unlimited width and to notch and cope angles and flanges of channels and I-beams.

The frame of this machine is of heavy armor-plate construction, electrically welded into a solid unit that is rigid under maximum load. The gears are of steel. An Alemite high-pressure system furnishes the machine with centralized lubrication. It has SKF high-speed bearings and full safety guards. The machine is made by the Buffalo Forge Company, Buffalo, N. Y.

Vertical Shaper With Hydraulic Ram Drive

While designed to perform work in the field of vertical shaping rather than the heavier operations of slottings, the Rockford 12-in. Hy-Draulic vertical shaper has the same general lines as the Rockford Hy-Draulic vertical slotter. This new machine, built by the Rockford Machine Tool Company, Rockford, Ill., has speed and accuracy in addition to the power and rigidity demanded by the heavier class of vertical shaping. The hydraulic drive of the ram is designed to give a total of 150 strokes per minute with a minimum stroke of one inch, while the table has micrometer adjustments for the setting of longitudinal and lateral travel.



The Rockford 12-in. Hy-Draulic vertical shaper

The ram bracket is mounted in the box-section column on trunnions which permit the ram to be tilted 10 deg. from the vertical. The hydraulically operated ram is mounted in heavy-duty shaper-type ways and it has an adjustable crosshead mounted on a screw to which the actuating piston is attached. The ram is furnished with a 360-deg. swiveling tool head. Dual start and stop levers, one on each side of the column, permit control of the ram from either side of the machine.

The hydraulic pump is mounted inside of the column and is driven by a constant-speed motor carried on a bracket on the left side of the column. The pump controls for setting the speed of the ram in both cutting and reverse strokes are mounted in the right side of the column. The hydraulic table-feed cylinder with its adjusting screw and feed-shaft bracket is also mounted on the right side of the column as is the table rapid-reverse motor. Both the traverse motor and the hydraulic feed operate in one direction through a common splined drive shaft.

The bed is a strong, ribbed casting securely bolted to the column. The rotary table is 28 in. in diameter and is carried on accurately scraped alloy-iron bearings having pressure lubrication which gives the table a high resistance to deflection under heavy cuts and freedom from run-out in rotation. The table is equipped with a manually controlled indexing or locking device actuated by a knurled knob at the front of the table. Rapid traverse is controlled from the motor-control pendant switch which also has jog and run positions.

Both the saddle and the slide are channelled to receive precision measuring bars which, in conjunction with dial indicators, give the same accuracy of setting in both the longitudinal and lateral movement of the table as is provided in jig-boring machines. This feature and a dividing head for accurate indexing of the rotary table may be obtained if ordered.

Constant-pressure lubrication from the hydraulic circuit is supplied to the ram. A one-shot lubricating unit supplies oil to all bearing and way surfaces of the saddle, cross slide, and rotary table. The gear boxes, main table-drive gearing, and all anti-friction bearings are permanently packed in grease.

Grinder With Built-In Electrical Controls

The Norton 6-in. by 18-in. type C cylindrical grinder has built-in electrical controls and is arranged for hydraulic traverse of the table. All mechanisms are easily accessible for adjustment. The

The Norton 6-in. grinding machine

coolant and oil pumps are individually motor driven, run submerged, and are spring mounted. A separate pump supplies the lubricant to the table- and wheel-slide ways.

The electrical controls are built into the back of the machine, and cored openings in the base are provided for that purpose and to keep them free from dust and dirt. The centralized controls permit the convenient and time-saving operation of the machine. The headstock has been equipped with an eccentric take-up of the drive chain for keeping it in proper tension. Larger centers is one of the improvements made in the headstock and footstock. Protective telescoping guards are furnished for the base ways as standard equipment. The unit-type construction which has been used throughout the machine is efficient from the standpoints of adaptability and maintenance. This grinder is made by the Norton Company, Worcester, Mass.

(*Turn to next left-hand page*)

… wheels has shown a … increase since the adoption of the single plate wheel. Today it is three times what it was in 1927, and the age of failed wheels has increased 80% to an average of 9.2 years. But this is not enough.

Chilled Car Wheel Inspection Service
Promises Better Performance

One of the major purposes of the rigid inspection system now operating in our Member plants is the further improvement of this record. To attain that end, we now maintain resident inspectors who follow every step of manufacture on every heat.

Our own release is necessary before chilled car wheels can even be offered for test and acceptance by the Railroads.

Already, the results show a far greater uniformity of output—a most encouraging beginning of this new feature of our Association work.

*Based on the performance of over 15,000,000 chilled car wheels in service.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

Organized to Achieve:
Uniform Specifications
Uniform Inspection
Uniform Product

*Average still based on performance of over 15,000,000 wheels in service.

The better performance we promised, as a result of our inspection service and continued manufacturing improvement, is already being realized. Further steps have been taken towards our goal "To make every wheel as good as the best."

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE,
NEW YORK, N. Y.

445 N. SACRAMENTO BLVD.,
CHICAGO, ILL.

ORGANIZED TO ACHIEVE:
Uniform Specifications
Uniform Inspection
Uniform Product

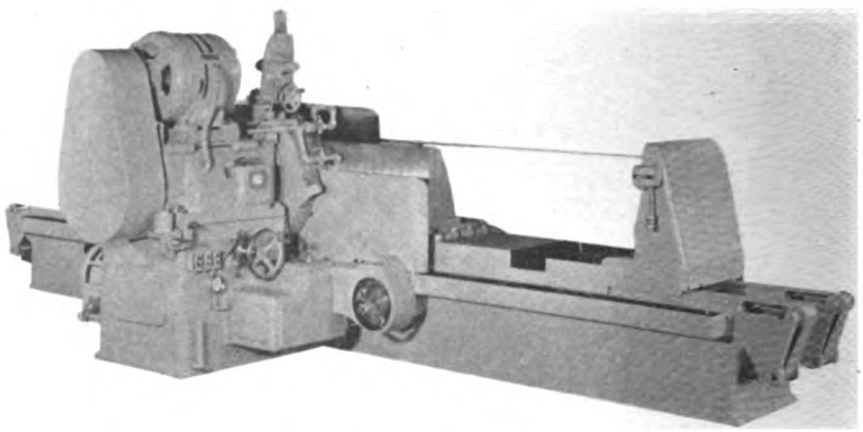
Face Grinder with Hydraulic Table Drive

Engineers of the Hanchett Manufacturing Co., Big Rapids, Mich., have developed a line of face grinders one of the features of which is a hydraulic table drive. Two pistons and cylinders are used, one to pull the table in each direction, rather than a single cylinder which pulls the table in one direction and pushes it in the other.

The table of the No. 986 face and knife grinder, illustrated, is 36 in. wide and 86 in. long. The table ways are lubricated with a forced-feed oiling system comprising a small motor, oil reservoir, pump, filter, and pressure gage. The ways are protected with a patented belt cover; the belts are joined to one end of the table, pass over the ends of the ways and entirely through the bed, and are fastened to the other end of the table. The table has an infinite range of speeds up to 90 ft. per minute.

The horizontal grinding-wheel spindle is mounted in Timken tapered spindle bearings of large diameter. The grinding wheel is of the segmental type holding abrasive blocks with a 2-in. or 3-in. face and is usually 30 or 36 in. in diameter. The 40- or 50-hp. grinding-wheel motor is placed on a hinged mounting directly above the spindle and the drive is through V-belts and sheaves. The grinding-wheel head is mounted so that the outer end can be adjusted up or down or swung to the right or left. This arrangement makes it possible to set the grinding wheel at exactly right angles to the top of the work table and also to swing the head around to provide clearance for the up-side of the grinding wheel. The grinding-wheel head has hand or automatic feed toward or away from the work being ground. A lever-operated hand brake on the wheel spindle enables the operator quickly to stop the wheel after the power is shut off. The motor is connected to a built-in ammeter which is important in determining the cutting efficiency of the grinding wheel.

The wheel-dresser head with a serrated-steel cutter mounted in a ball-bearing spindle has an adjustment to compensate for the wear of the spindle. All of the controls, including the coolant supply and the dog set for the length of the table stroke, are within reach of the operator in his usual working position.



The Hanchett No. 986 face and knife grinder with horizontal spindle

Horizontal Boring Machine

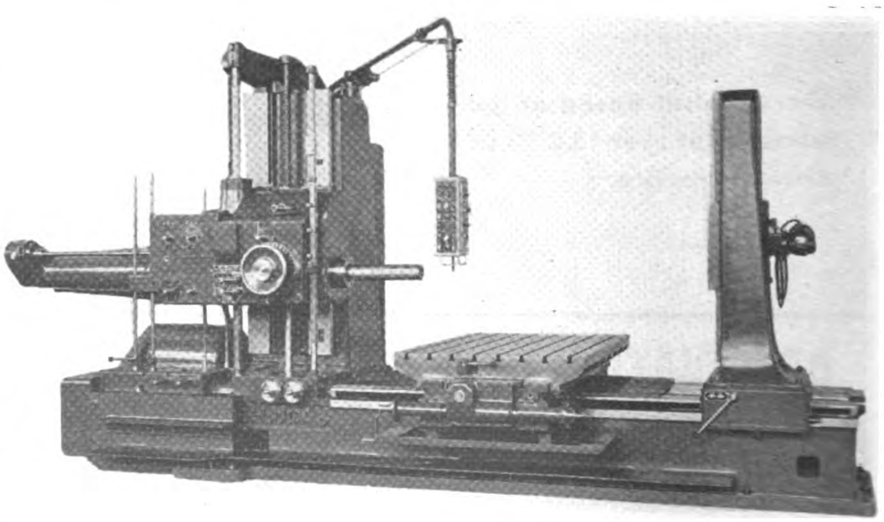
Convenience of control and operation is a feature of the new No. 436 horizontal boring machine built by the Lucas Machine Tool Co., Cleveland, Ohio. It has multi-position, electric-pendant, directional control of spindle rotation and the traverse of all sliding units including the spindle, and Hi-Lo dual control (at the head or bed level) for shifting gears in the speed and milling feed-change gear boxes located on the bed where there is ample room for a large-size mechanism and the weight does not have to be counterbalanced. This arrangement leaves space in the head for final spindle-driving gears of unusually large diameter for slow-speed high-power drives. The fast speeds are transmitted by multiple V-belts to the rigid 4½-in. diameter main spindle, having a 48-in. continuous traverse by means of a lead screw. This construction is adapted for the provision, if desired, of thread leads for screw cutting. Spindle feeds are taken off the spindle sleeve and are not affected in the rate per revolution by spindle-speed changes. All gears run in oil.

A large dial on the front of the head indicates directly the distance the spindle extends beyond the face plate and serves as a depth gage for the full 48-in. traverse of the spindle. An adjacent dial can be set to trip out the spindle feed automatically at any desired position within its full range of traverse. All motions have power rapid traverse and are provided with electric limit switches. Adjustable trips serve automatically to feed and rapid-traverse the table thereby expediting the milling of interrupted surfaces such as spaced pads. The provision for the instant shifting from cross feed of the table to the vertical feed of the head, or in the reverse order, facilitates milling around rectangular edges.

Because of the weight of the sturdy back rests of these large boring machines an individual motor with directional push-button control is installed on the base for traversing the back rest longitudinally along the bed. When the back rest is clamped to the bed, the clamp lever covers the control buttons so the traverse motor can not be operated. The back-rest block is clamped in the vertical position by means of a torque motor which is automatically operated by remote control simultaneously with the head clamps and is interlocked with the vertical feed, thus insuring safety and saving the operator many steps. The saddle clamps are interlocked in a similar manner with the power motion.

Steps along the front of the bed and sides of the saddle at the front end lead to sectional covers across rigid permanent covers protecting the bed ways. These steps and covers have non-slip treads for the safety of the operator when he is standing in a convenient position to reach long or high jobs while setting up, adjusting tools, or watching cuts.

All these advantageous features are obtainable in the larger new model No. 548 machine with 5-in. spindle and with a bed 48 in. wide and in the No. 560 machine with a 60-in. bed.



The Lucas No. 436 horizontal boring machine

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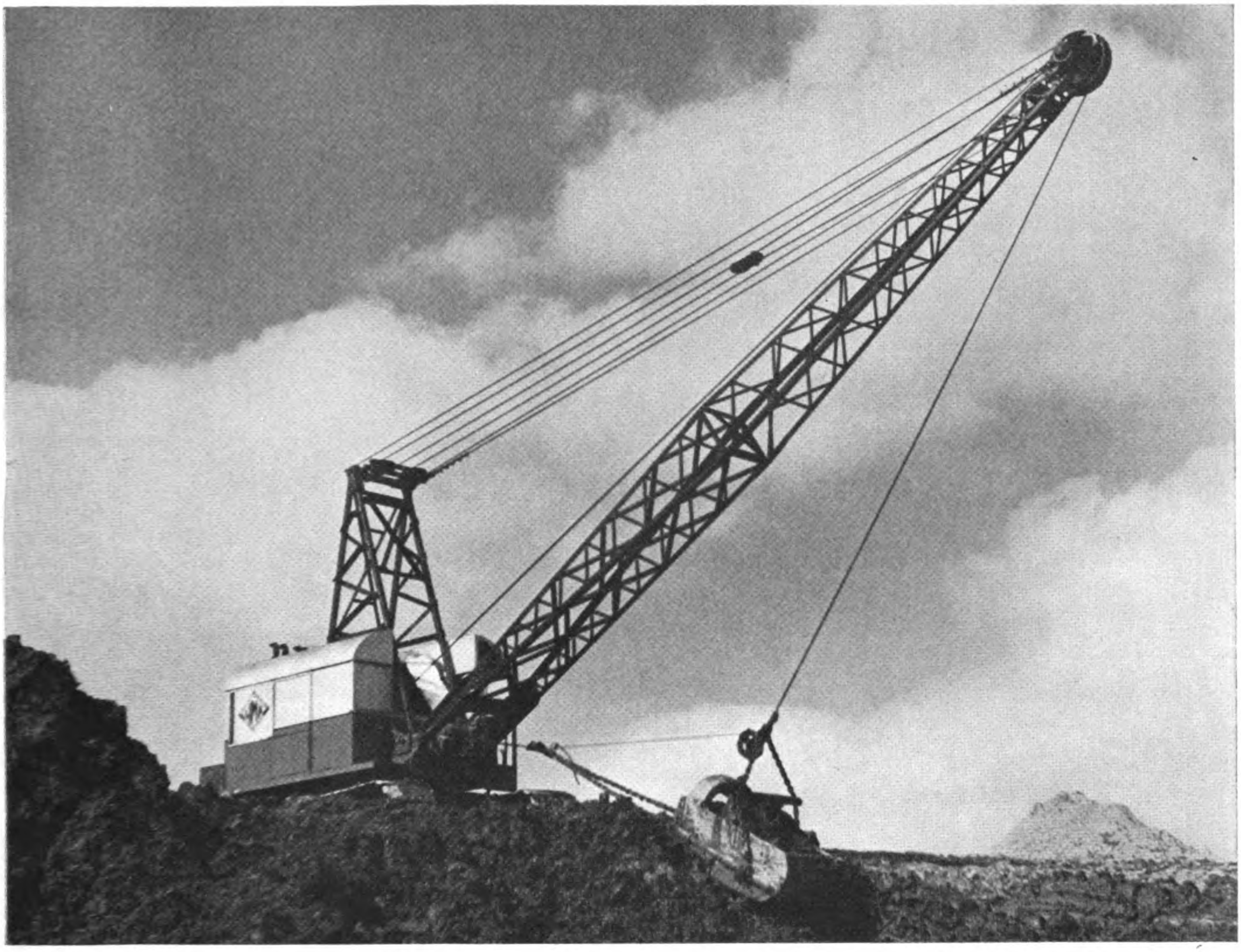


LIMA POWER SHOVELS, CRANES AND DRAGLINES

are built to "Lima Quality" Standards

The high quality of manufacture that railroads associate with Lima locomotives is also present in Lima power shovels, cranes and draglines.

Modern in design, this line of equipment, from three-quarter yard to four yard capacity, is serving well the leading contractors of the country as well as many railroads.

Its dependability makes it favored where the going is toughest.

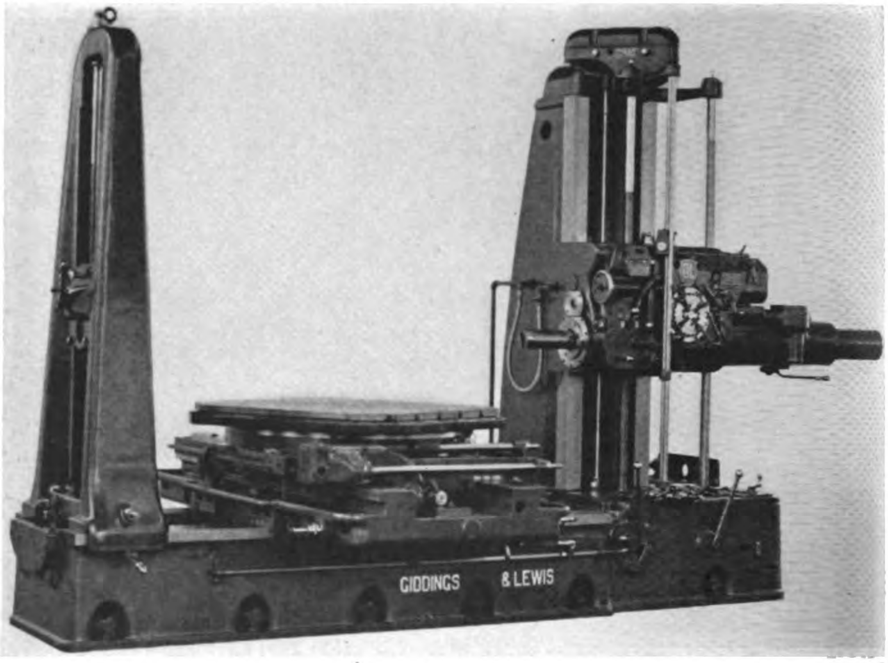
LIMA LOCOMOTIVE WORKS, LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

Built-In Revolving-Table-Type Machine

A built-in-power revolving-table-type machine is the newest addition to the 30-Series of high-power, precision, horizontal boring, drilling, and milling machines built by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. This machine incorporates all the features of the standard 30-Series table-type machines and has, in addition, the power revolving table. This design increases flexibility and reduces set-up costs because the revolving table allows complete turning of the job to any position within the full 360 deg., permits the machining of a job on different sides at one set up, and eliminates the necessity for mounting and dismounting an auxiliary revolving table with the resulting time-consuming operations.

The table top on this machine is approximately 7 in. lower than that of the standard table-type machine with a mounted auxiliary revolving table. This distance means an increase in the vertical range of the headstock, greater convenience for the operator, and greater rigidity because the revolving table is an integral part of the machine and is mounted closer to the bed.

The rotary movement of the table has 18 rotary feeds and a rapid traverse while the 48-in. cross travel of the table is also furnished with 18 feeds and a rapid traverse. The table is graduated in ½ deg. and has four indexing stops with a hand adjustment to .001 in., obtained through a micrometer dial at exact 90-deg. intervals. Additional indexing intervals may be obtained.

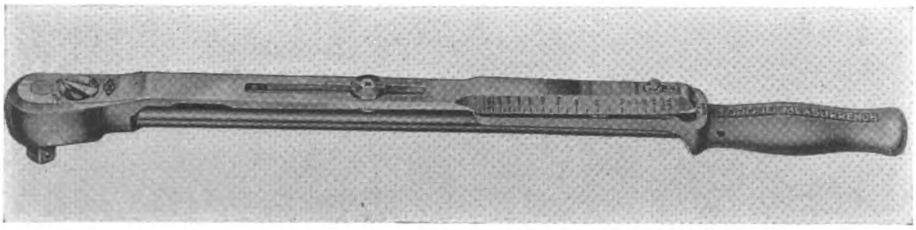


Giddings & Lewis 30-series 340-RT built-in-power revolving-table-type machine

Wrench Indicates Applied Torque

The No. S-57 torque Measurrench announced by J. H. Williams & Co., New York, indicates applied right-hand torque and has mechanical features which make it an efficient and durable tool. It is a reversible ratchet wrench for use with any detachable socket having a ½-in. square drive. The wrench may be used in two ways: (1) By sight reading of a calibrated scale which shows applied torque from 20 to 200 ft. lb., and (2) by sound reading in which a sharp sound signal is given for any pre-determined torque from 35 to 200 ft. lb.

The 36-tooth ratchet wheel with a patented twin double-tooth pawl makes possible the unusually short operating swing of one-thirtieth of a full turn. The wrench action is instantly reversed for left-hand turning by a flip of the shifter and is flush with the head which is compact and free of protrusions. Every part is made of high-tensile alloy steel, accurately machined and heat treated. The wrench is 19½-in. long and is finished in chrome-plate.

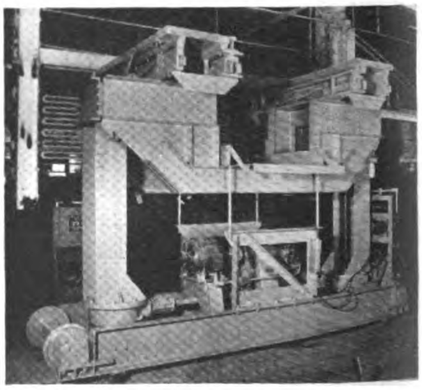


The Williams No. S-57 torque Measurrench

Two-Screw Drop-Pit Table

The two-screw model B drop table shown in the illustration is made by the Whiting Corporation, Harvey, Ill. This 30-ton capacity machine is for use by a western railroad at its Diesel-electric shop for removing single pairs of power wheels, including the motors, from Diesel-electric locomotives and single pairs of wheels from under coaches. It is equipped with a goose-neck lifting beam with flooring in the depression at its middle in order to have this flooring level with the inspection pit when the table top is locked in position at ground level.

The detachable table top is made in two halves and because of this arrangement each half has outside locking bars in addition to the conventional locking bars located below the table-top rails. The motor drives an enclosed herringbone gear reducer. The reducer drives the single shaft that revolves the two bevel gears in the end housings that turn the two hoisting screws. The goose-neck lifting beam is equipped with two upper and two lower rollers at each end which bear against the outside of the flanges of the vertical end beams. This table is motor racked and has a power cable take-up reel. The machine is easily hand racked because the truck wheels are mounted on roller bearings.



The Whiting two-screw drop-pit table in a raised position

The two-screw model B drop table can be obtained with a straight lifting beam and conventional table top. The table-top width and the machine capacity can be increased to handle the largest pair of drivers under modern steam locomotives as well as the Diesel-electric locomotive wheels. It is adaptable for use on small railroads having a few locomotives and on large railroads at outlying points where tables are needed and a low-cost installation is practical.

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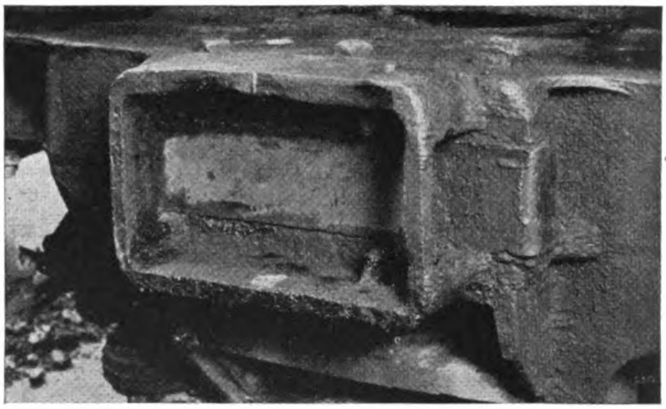
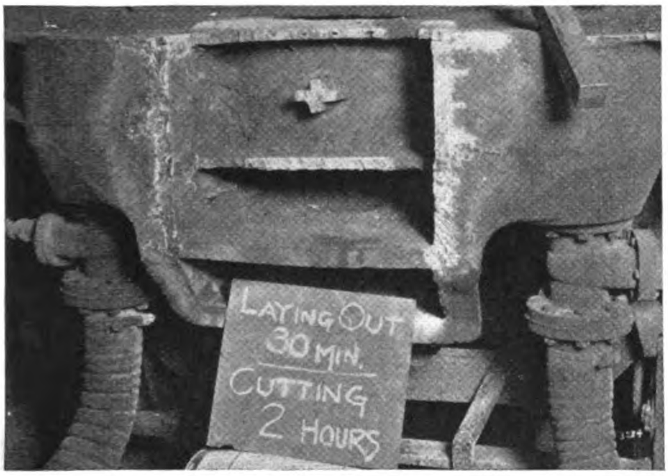
ELIMINATE EXCESSIVE VIBRATION

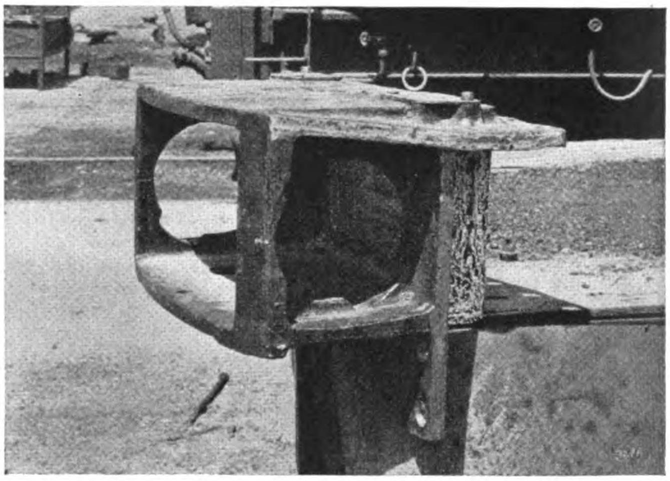
by making this simple installation of an E-2 Radial Buffer



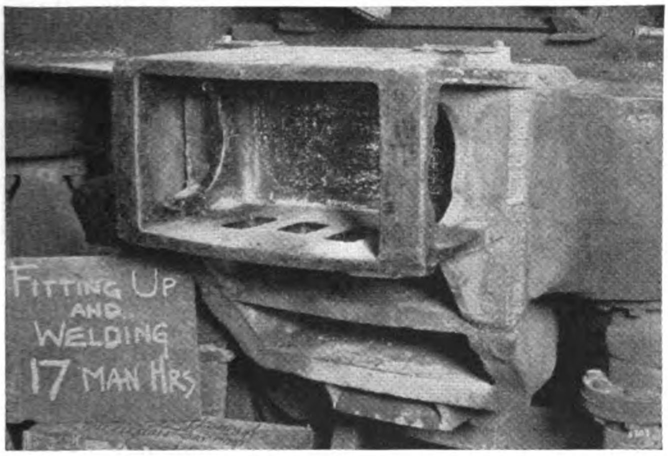
1 Old-style chafing plate pocket before laying out and cutting for application of E-2 Radial Buffer.



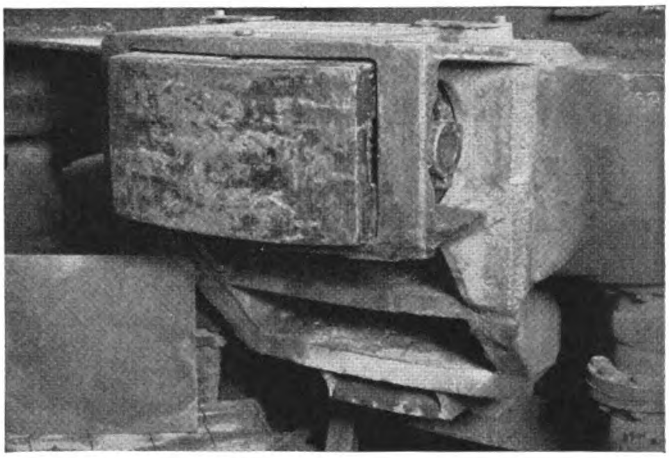
2 View showing cut-out section for application of E-2 chafing plate pocket.



3 Chafing Plate Pocket of E-2 Radial Buffer ready for installation in cut-out section illustrated on the left.

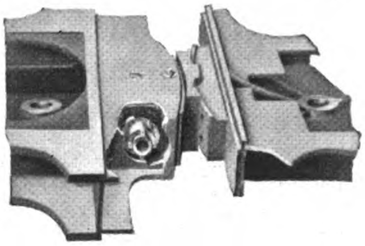


4 Welded to tender frame chafing plate pocket of E-2 Radial Buffer prior to installation of internal parts.



5 View showing assembled unit — tender end.

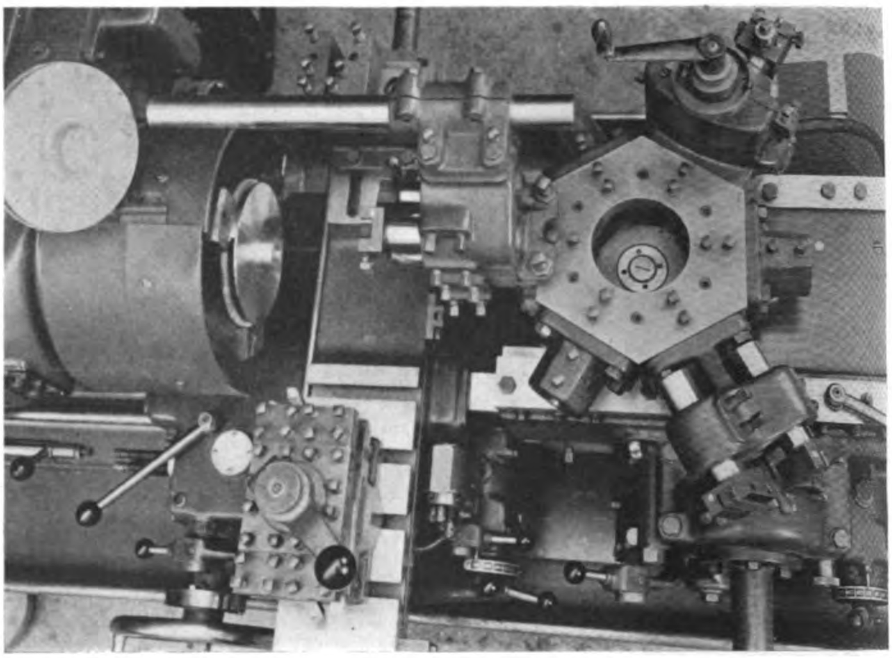
Excessive vibration can be avoided, and passenger comfort increased, by the application of the E-2 Radial Buffer. The Buffer can be installed in less than two days. It permits full freedom of lateral and vertical movement, assures maximum safety, and results in engine and tender becoming a single unit with vastly improved riding qualities and lowered maintenance.



FRANKLIN RAILWAY SUPPLY COMPANY, INC. NEW YORK CHICAGO MONTREAL

Rapid Traverse For Lathe Cross Slide

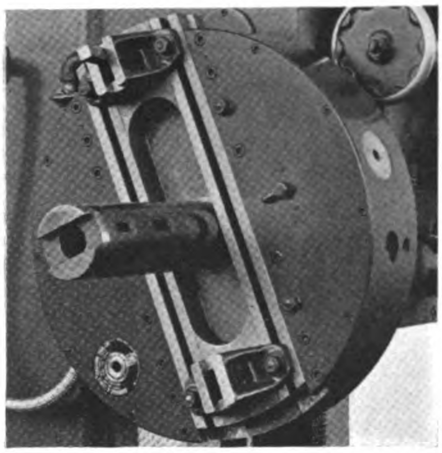
The cross slides of both the ram- and saddle-type universal turret lathes of the Jones & Lamson Machine Company, Springfield, Vt., can now be furnished with power rapid traverse. The illustration is a view of a No. 5 J. & L. ram-type universal turret lathe equipped with this attachment and tooled to machine a bronze pump impeller. On jobs like this where fast cutting tools are used and even long facing cuts are made in six seconds or less, the power rapid traverse of the cross slide reduces human fatigue and brings the handling time closer to the actual cutting time.



A Jones & Lamson ram-type universal turret lathe equipped with power rapid traverse for the cross slide

Continuous-Feed Facing Head

A new accessory of unusual flexibility, the continuous-feed facing head, has been added to the line of auxiliary equipment for horizontal boring, drilling, and milling machines made by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.



Giddings & Lewis continuous-feed facing head mounted on 30-Series headstock with the main spindle extended

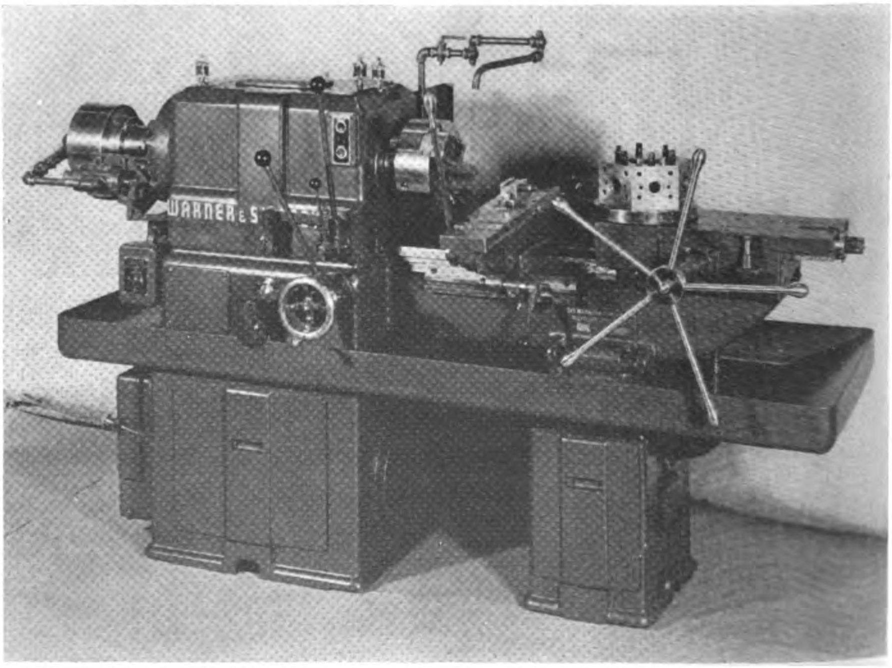
It is arranged for attachment to the spindle sleeve. It has a hardened ground bushing through which the main spindle can slide freely, making it possible to perform facing and boring operations at the same time. A feed unit to provide six continuous feeds from .006 in. to .125 in. per revolution in geometrical progression is built into the facing head to feed the cross-slide for facing operations. A shifting lever is used to engage the power feed and control the direction of the feed. When the power feed is disengaged, the head may also be used as an extremely large offset boring head for single-point tool boring and, in order to adjust the cross-slide for this class of work, a micrometer dial graduated in thousands of an inch is furnished.

Such operations as counterboring, boring of large-diameter holes, facing, turning and grooving-flanges, recessing and countersinking are performed accurately and easily with this unit. The continuous-feed facing head may be attached or removed from the machine in a very few minutes.

Turret Lathe For Brass Work

A new turret lathe for brass work has been designed by the Warner & Swasey Co., Cleveland, Ohio. It has a 16¾-in. swing, a simple, direct, two-speed drive and an electrically operated mechanical brake, and is built for high-speed operation and cutting. The turret slide and saddle are completely guarded to keep chips out of the operating parts.

One of the features of the lathe is the automatic control of the two spindle speeds and the reverse which is operated by the movement and indexing of the hexagon turret. With this equipment, the operator only starts and stops the machine and sets the controls. The machine will go through automatically any cycle of the two speeds and forward and reverse. It is designed to be equipped with a stationary air cylinder to permit the faster reversal of the spindle. Diagonal ribbing, similar to bridge truss bracing, will be standard on all Warner & Swasey lathes.



The Warner & Swasey turret lathe designed especially for brass work

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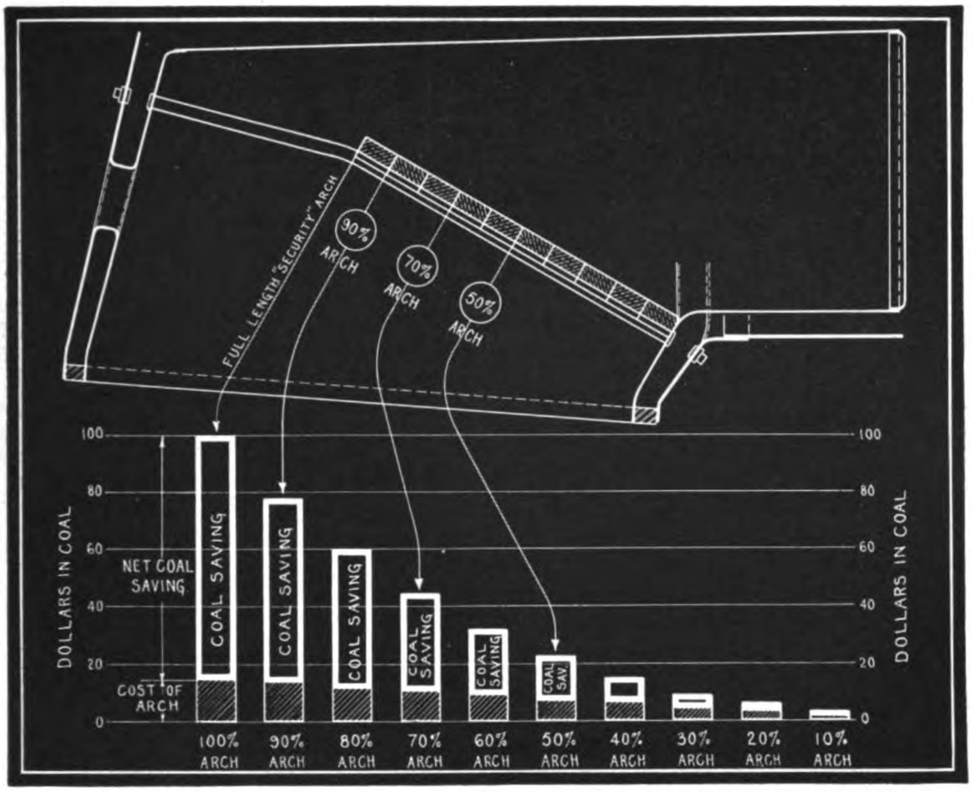


THE EFFECT OF ABBREVIATED ARCHES ON FUEL SAVING

LET THE ARCH HELP YOU SAVE

With the emphasis being placed on saving every railroad dollar, the locomotive Arch becomes increasingly important.

Regardless of the amount of traffic handled, the locomotive Arch saves enough fuel to pay for itself ten times over.

Be sure that every locomotive leaving the roundhouse has its Arch complete with not a single brick nor a single course missing.

In this way, you will get more work for each dollar of fuel expense. Skimping on Arch Brick results in a net loss to the railroad.

THERE'S MORE TO SECURITY ARCHES THAN JUST BRICK

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.

Locomotive Combustion Specialists

High Spots in
Railway Affairs . . .

Railroad Employment Climbing

Increased business and the speeding up of the maintenance programs made it necessary to increase considerably the number of employees on the railroads during the month of September. The exact figures for this increase are not yet available, but it is interesting to note that there has been a steady growth in railroad employment during recent months, even before matters reached a crisis on the other side. The I.C.C. preliminary figures for mid-August, for instance, showed 1,004,619 employees, an increase of 0.25 per cent over the previous month, and of 6.9 per cent over mid-August, 1938. That there has been a concentration on maintenance is indicated by the fact that both the maintenance of way and structures and the maintenance of equipment and stores forces were up a little more than 11 per cent, as compared to a year ago, while the increase in the train and engine service group was only 5.21 per cent.

Railroad Man Canadian Censor

No one can doubt the earnestness of purpose with which Canada has entered the war. Certainly it has shown excellent judgment in selecting Walter Scott Thompson, chief of the Canadian National's publicity organization, to become director of censorship, including press, radio, mail and cables. Mr. Thompson is known as the "dean of Canadian publicity men" and is one of the most widely traveled men in Canada, having covered some 50,000 miles a year for the Canadian National in maintaining contacts with newspaper men and writers.

Joe Eastman's Advice to Employees

Chairman Joseph B. Eastman of the Interstate Commerce Commission, rested by a recent vacation in the Canadian woods, made some very frank suggestions at the meeting of the New England Shippers Advisory Board at Burlington, Vt. It is a bit unusual on such occasions to refer to employee relations, but the commissioner did indicate that the railroad employees can be very helpful in improving conditions. "I think from their point of view, as well as from the point of view of the public," said the commissioner, "they might well pay less rigid attention, may be less combative, less insistent, to rights and privileges and working rules, which were recognized in the old days but which do not fit modern conditions any more than the old-fashioned passenger coach fits the modern passenger travel. I think they can be more co-operative in seeking economy and efficiency in the railroad operation, and also more considerate of the public. I mention that for their own sake as well as for the sake of the public, because I think they will find, unless they do adopt that attitude, that there are victories which can be turned into defeat, and they will find some of the policies which they seem inclined to pursue do them more harm than good."

Pipe Lines Extending Fast

There has been unusual activity in the construction of pipe lines for conveying crude oil, natural gas and gasoline during the first nine months of this year; indeed, the Oil and Gas Journal states that there has been more activity than in any similar period since 1930. Over 4,000 miles of new line has been recently completed or is now being laid, representing an expenditure of about $100,000,000 thus far this year. It is said that the transportation of gasoline through pipe lines is becoming increasingly important. Some of the old crude-oil lines are being reconditioned or converted to this purpose. It is estimated that a total of 1,180 miles of pipe lines for gasoline transportation will be constructed in this country this year.

Jesse Jones Says a Good Word for the Railroads

The railroads are unaccustomed to receiving very much in the way of commendation from people high in government authority. Jesse Jones, federal loan administrator, in his press conference on September 18, patted them on the back a bit, however, when he suggested that the railroads have done a pretty good job, considering the small amount of revenue they have had in the last few years. He pointed out that the railroad outlook is now more favorable than it has been for several years. Business has been picking up generally and the prospects are bright for additional traffic. He concluded with the statement that the railroads "are thoroughly alive to their responsibility in this emergency, if this can be called an emergency." Much more to the point, Mr. Jones indicated that the government was in a position to advance funds for additional new railroad equipment as well as for equipment repairs. He pointed out, however, that most of the railroads are getting their money privately at lower rates than the R.F.C. can provide. In case interest rates harden, as is quite likely, the carriers which do not have private commitments may have to call upon the R.F.C.—and presumably Mr. Jones will accommodate them.

Freight-Car Loadings For Fourth Quarter

Compilations made by the thirteen shippers advisory boards indicate an increase of about 13.8 per cent in freight-car loadings in the fourth quarter of 1939, as compared with those of last year. Apparently, however, this estimate is based on replies to the questionnaires which were submitted to the individual shippers early in September and before the effect of the European conflict could be properly evaluated. Without doubt the increase in loadings will be much greater than was estimated; in fact, it is understood that a recanvass may be made early in October and a revised forecast issued. The sudden spurt in orders for railway equipment and supplies, in itself, should be an important factor in the movement of a much larger amount of freight in the next few months.

Keep the Cars On the Move

Many reports have been received indicating that the mechanical departments of the railroads are speeding up their programs of freight-car maintenance. Large numbers of new freight cars are also being ordered. The big problem as business increases is to get the greatest amount of service out of every single piece of equipment. An analysis of freight-car operation indicates clearly that the weak spot today is in the time that the cars are held by the shippers and receivers of freight. This is not due to lack of interest on their part, but rather because there has been a surplus of equipment for a long time and the shippers and receivers of freight have not been under any pressure to load or unload the cars promptly or otherwise co-operate in getting a maximum amount of service out of them. As part of the game to speed up operations to insure that the present equipment will meet the current requirements, even though they should be greatly intensified, the Car Service Division of the Association of American Railroads has drawn up ten suggestions—not commandments—from (a) to (j), telling exactly how the shippers and receivers of freight may co-operate to the very best advantage. Judging from the fine way in which the Regional Shippers Advisory Boards have co-operated with the railroads for many years, there is little question but what they will join heartily with the railroads in this game of securing the greatest possible utilization of the equipment. The Car Service Division has also issued a statement to the railroads concerning specific measures which they should adopt which will keep the cars on the move and insure maximum capacity from the equipment.

(*Turn to next left-hand page*)

THE SUPERHEATER AS A FACTOR IN LOCOMOTIVE DESIGN

Maximum Ton Miles Per Hour

	BOILER DIAMETER	TRACTIVE FORCE
#1	$87\frac{5}{8}$"	43,300
#2	89"	44,500

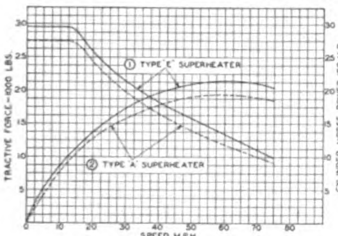


FIG. No. 1

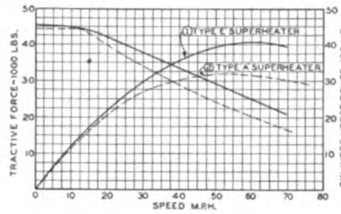


FIG. No. 2

This requires a locomotive delivering highest sustained tractive effort at high speeds, within clearance and weight limits.

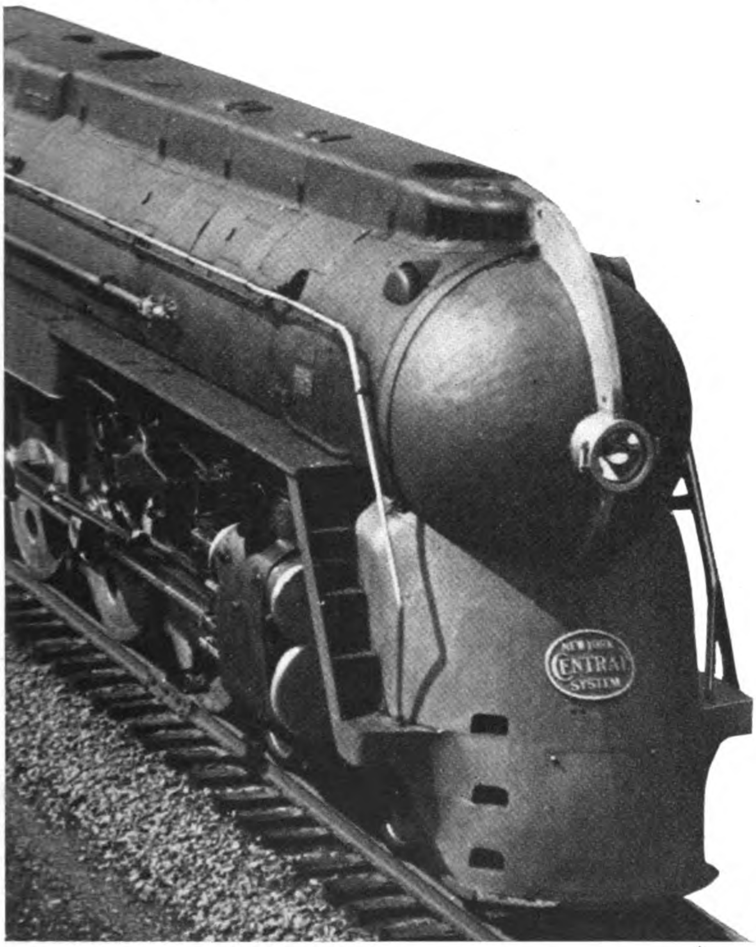
The curves illustrate the comparative tractive effort and horsepower capacity of locomotives during actual road tests.

Figure No. 1 indicates the results of a test of identical locomotives, differing only in the type of superheater.

Figure No. 2 shows comparative tests of two locomotives with practically the same boiler diameter and tractive power.

* *

The great improvement shown in tractive effort and sustained horsepower at high speeds with the Elesco Type "E" superheater-equipped locomotive, is typical of Type "E" performance.



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ELESCO

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NEWS

High Locomotive Efficiencies—A Correction

The statement in the sixth line from the bottom of the first column on page 346 of the September issue is incorrect. It should read: "The only difference between them was that *A* had been in the stock pile longer," not *B*.

No Car Shortage Foreseen by A. A. R.

Association of American Railroads' estimates of the amount of additional freight traffic that the railroads could handle by using the present equipment surplus and repairing bad-order cars and locomotives were increased from 45 to 50 per cent following a meeting on September 8 of the executive committee in Washington, D. C. The 45 per cent figure had been included in a statement issued a few days earlier by A. A. R. President J. J. Pelley who also said that 25 per cent additional traffic could be handled with equipment now owned and in its present condition. While upping his other figure five per cent, as noted above, the executive committee affirmed this 25 per cent estimate of Mr. Pelley.

The A. A. R. press release on the executive committee's follow-up set forth the committee's formal statement in part as follows:

"During the year 1929 the railroads handled approximately eight million more carloads of freight than were handled during the war year of 1918, and did it without car shortage or congestion of any kind.

"The railroads, with equipment now owned and in its present condition, could handle a minimum of 25 per cent more than present business. By putting in serviceable condition the cars and engines now awaiting repair because they are not needed for present business, the railroads could handle 50 per cent more than present business. This volume of traffic would be more than the peak load of the war year of 1918.

"In addition to improved methods of keeping equipment in movement in emergencies, the whole timing of railroad operation has been speeded up since the time of the last general car shortage, now more than fifteen years ago. Freight trains are more than 60 per cent faster, on the average, than they were in 1920, while the average output of transportation for each hour that trains are on the road has been more than doubled in the same period.

"Equipment is constantly wearing out and new equipment is always required. During 1939, more than 10,000 new cars and 139 new locomotives have been placed in service, and there are now on order another 11,000 new cars and 118 new locomotives. As traffic and earnings may increase, such additional equipment as is required and justified can be had in advance of needs.

"But even with present equipment, the speedier movement of trains and better utilization of cars today will enable the railroads to keep ahead of any anticipated demands."

Equipment-Purchasing and Modernization Programs

Canadian National-Canadian Pacific.—Transport Minister Howe of Canada announced recently that the Dominion government will purchase $25,000,000 of new railway equipment, which will then be sold to the Canadian National and the Canadian Pacific and equipment trust certificates or the equivalent taken in return by the government. About $15,000,000 of the new equipment would be for the Canadian National and the rest for the Canadian Pacific. The equipment will consist of some locomotives, and the balance will be box cars and long flat cars.

Chicago, Burlington & Quincy.—The directors of this road have approved an equipment program which includes the purchase of 10 4-8-4 type freight and four Diesel-electric passenger locomotives. The company will also buy or build 100 flat cars.

A heavy repair program scheduled by the Burlington for the balance of 1939 involves 71 locomotives and 4,812 freight cars. So far this year, 106 locomotives and 3,890 freight cars have undergone heavy repairs. In the latter, the construction of 182 new 50-ton box cars is included.

The 71 locomotives to be repaired include nine 2-10-4 Texas type, which will be converted to high-speed freight locomotives by the application of roller bearings to the engine trucks, drivers, tender trucks and valve motion, lightweight rods, reciprocating parts and valves and other improvements; two 4-6-4 Hudson type which will be converted to high-speed passenger locomotives by the application of roller bearings to drivers, trailers and valve motion, lightweight rods and lightweight reciprocating parts and valves and other improvements; and three 4-6-4 Hudson type and three 4-8-4 Mohawk type, which will be improved by the application of lightweight rods, lightweight reciprocating parts and valves.

Chicago, Milwaukee, St. Paul & Pacific.—The federal district court at Chicago has authorized the trustees of the Milwaukee to spend $139,300 to enlarge 398 freight cars to accommodate 1940 model automobiles.

The road will ask the court for permission to spend $10,000,000 for locomotives, freight cars and rails, financing to be done in part by the sale to the Reconstruction Finance Corporation of equipment trust certificates. Ten 4-8-4 type freight locomotives are being purchased from the Baldwin Locomotive Works and 2000 50-ton box cars will be built in company shops. Work on the new box cars will be started upon completion of 1,000 50-ton box cars now being built in its Milwaukee shops.

Chicago, North Shore & Milwaukee.—The C., N. S. & M. has received court approval for the complete modernization of 25 all-steel passenger cars in its own shops at a cost of $89,450. New heating, ventilating and lighting systems and new seats will be installed, before the cars are redecorated.

Delaware, Lackawanna & Western.—The car repair program of the Lackawanna calls for rebuilding 600 coal cars of 50 tons' capacity, at its Keyser Valley shops, Scranton, Pa. Inquiries, as noted elsewhere, are being made for 500 50-ton box cars, 500 50-ton hopper cars, and 100 70-ton gondola cars.

Illinois Central.—The Board of Directors of the Illinois Central has approved the expenditure of $8,000,000 for new equipment and repairs to existing equipment. As a result, an inquiry for freight cars has been revived and the railroad is now inquiring for 750 gondola cars, 750 50-ton hopper cars and 1,000 40-ft. box cars. Inquiries have also been issued for 10 Diesel-electric switching and transfer locomotives for use in the Chicago terminal where they will replace existing steam locomotives.

Missouri Pacific.—The Missouri Pacific's 1939 equipment rehabilitation program, started in August, provides for general repairs to 466 freight cars, including 66 hopper cars of 55-tons capacity, 200 government type gondola cars and 200 gondola cars. The rebuilding of four baggage cars in its own shops has been completed.

New York Central.—The New York Central is planning an equipment-purchasing and modernization program to cost over $10,000,000, according to a recent announcement made by President F. E. Williamson. The purchase of 3,500 steel hopper cars of 55 tons' capacity and 500 box cars, 50 ft. long, noted elsewhere in this issue, are included in the program. Prices are also being asked on material for 500 freight cars of 55 tons' capacity.

Norfolk & Western.—The Norfolk & Western has recently ordered materials for the renewal of bodies of 1,000 hopper cars.

Pennsylvania.—M. W. Clement, president of the Pennsylvania, has announced an extensive program of equipment and property improvement involving an expenditure of almost $17,000,000. The program will include 2,500 new freight cars, 20 new electric locomotives, 3 new streamlined passenger cars, 15 modernized passenger cars, and rail. Repairs to the railroad's freight cars are being undertaken in company shops on a schedule providing for the repair of 17,500 hopper gondolas and box cars.

Since 1929 the company has added more than 27,000 new freight cars to its fleet. The new freight cars in this program will include 2,000 all-steel box cars, 40 ft. long

and 10 ft. high and 500 all-steel automobile box cars, 50 ft. long and 10 ft. high. Of the 40-ft. box cars, 1,000 will be built with single side doors and 1,000 with the double side doors, and all of the automobile cars will have double side doors. The 20 electric locomotives, geared for a speed of 100 m.p.h., will be of the streamlined GG-1 type for service between New York, Philadelphia, Pa., Baltimore, Md., Washington, D. C., and Harrisburg, Pa. The 15 all-steel modernized passenger cars and the 3 new streamlined passenger cars will be used in the de luxe coach service on through trains. Work on the new freight cars, the remodeled passenger cars and on the chassis of the electric locomotive will be carried out at the railroad's Altoona, Pa., shops.

New Equipment Orders and Inquiries Announced Since the Closing of the September Issue

LOCOMOTIVE ORDERS

Road	No. of Locos.	Type of Loco.	Builder
Boston & Maine	3	4-8-2	Baldwin Loco. Works
Chicago, Burlington & Quincy	10[1]	4-8-4	Company Shops
Chicago, Milwaukee, St. Paul & Pacific	10	4-8-4 frt.	Baldwin Loco. Works
Detroit, Toledo & Ironton	2	2-8-4	Lima Loco. Works
Erie	3[2]	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	4[2]	600-hp. Diesel-elec.	American Loco. Co.
Louisville & Nashville	1[3]	Diesel-elec.	Electro-Motive Corp.
	1[3]	Diesel-elec.	American Loco. Co.
Norfolk & Western	10	2-8-8-2	Company Shops
Seaboard Air Line	7[4]	2,000-hp. Diesel-elec.	Electro-Motive Corp.

LOCOMOTIVE INQUIRIES

Road	No. of Locos.	Type of Loco.	Builder
Canadian Pacific	12	4-6-2	
	12	Mikado	

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
New York, Ontario & Western	2[5]	Rail motor cars	American Car & Fdry. Co.

PASSENGER-CAR INQUIRIES

Road	No. of Cars	Type of Car	Builder
Canadian Pacific	10	Mail and express	

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Chesapeake & Ohio	100	Gondola	Greenville Steel Car Co.
	400	Gondola	American Car & Fdry. Co.
	500	Hopper	
	650	Hopper	Pullman-Std. Car Mfg. Co.
	700	Hopper	General American
	150	Hopper	Ralston Steel Car Co.
Chicago & North Western	500	70-ton hopper	Pullman-Std. Car Mfg. Co.
	300	50-ft. box	Mt. Vernon Car Mfg. Co.
Delaware & Hudson	500	50-ton hopper	American Car & Fdry. Co.
	500	50-ton hopper	Bethlehem Steel Co.
Detroit, Toledo & Ironton	25	70-ton covered hopper	American Car & Fdry. Co.
Erie	500	50-ton box	American Car & Fdry. Co.
	200	50-ton box	Pullman-Std. Car Mfg. Co.
	200	50-ton hopper	
	300	50-ton hopper	General American
	250	70-ton gondola	Greenville Steel Car Co.
	50	70-ton flat	Youngstown Steel Car Co.
Illinois Central	750	50-ton gondola	General Amer. Trans. Corp.
	750	50-ton hoppers	Pullman-Std. Car Mfg. Co.
	500	40-ton box	American Car & Fdry. Co.
	500	40-ton box	Mt. Vernon Car Mfg. Co.
New York Central	3,500	Hopper	Despatch Shops, Inc.
	500	Box	
Norfolk & Western	1,250	Hopper	Virginia Bridge Co.
	1,250	Hopper	Ralston Steel Car Co.
	1,000	Hopper	Bethlehem Steel Co.
Tenn. Coal, Iron and Railroad Co.	49	70-ton ore	Pullman-Std. Car Mfg. Co.
Union Pacific	2,000[6]	Box	Company Shops
Virginian	1,000	Hopper	Company Shops
Wheeling & Lake Erie	400	50-ton hopper	Pullman-Std. Car Mfg. Co.
	100	50-ton hopper	Ralston Steel Car Co.
Wisconsin Central	100	Auto box	Pullman-Std. Car Mfg. Co.
	100	Flat	

FREIGHT-CAR INQUIRIES

Road	No. of Cars	Type of Car	Builder
Baltimore & Ohio	1,000	50-ton hoppers	
	500	50-ton box	
	500	70-ton gondola	
Bessemer & Lake Erie	1,000	90-ton hopper	
	500	50-ton gondola	
	500	50-ton box	
Canadian Pacific	1,000	40-ton box	
	100	Auto	
	200	35-ton refrigerator	
Chicago & Illinois Midland	100	70-ton hopper	
Chicago Great Western	100	50-ton flat	
Chicago, Rock Island & Pacific	500-1,000	50-ton box	
Delaware, Lackawanna & Western	500	50-ton box	
	500	50-ton hopper	
	100	70-ton gondola	
Elgin, Joliet & Eastern	500	50-ton gondola	
	1,000	50-ton hopper	
Louisiana & Arkansas	250-500	50-ton box, 40 ft. 6 in. long	
	250-300	50-ton box, 50 ft. 6 in. long	
Union Railroad	100	70-ton air dump	
Youngstown & Northern	100	70-ton gondola	

[1] The building of these locomotives at West Burlington, Iowa, contemplated.
[2] The Erie has asked the federal district court for authority to purchase these locomotives.
[3] Delivery accepted for use in Louisville, Ky., yards.
[4] Order signed by receivership court approving orders placed by receivers. The seven locomotives are in addition to the two ordered from Electro-Motive as noted in the August issue.
[5] Double-end control. Application for permission to purchase this streamline air-conditioned equipment approved by federal court in New Jersey.
[6] To cost approximately $6,000,000. These cars will be of similar design to the 3,400 built in company shops this year. Seven hundred special lightweight automobile cars have also been built in company shops this year. With the construction of the new lightweight cars, the Union Pacific also is initiating a distinctive new color scheme for freight cars. Each of the cars designated for its Challenger merchandising service is painted a battleship gray, the lettering being in bright red.

American Welding Society Meeting

The use of welding on railroads will be featured by the American Welding Society at a session during its twentieth annual meeting to be held at Chicago on October 22 to 27. At the railroad session, beginning at 9:30 a. m., on October 27, three papers will be presented, including one on Maintenance of Way Welding, by C. E. Morgan, superintendent of work equipment of the Chicago, Milwaukee, St. Paul & Pacific, another on Automatic Welding in the Design and Construction of Railroad Rolling Stock by F. C. Hasse, general manager of the Oxweld Railroad Service Company, and a third on Production Spot Welding in the Manufacture of Freight and Passenger Cars, by J. W. Sheffer, assistant engineer of the American Car and Foundry Company.

"Bumping" Interpreted by Retirement Board Counsel

An unemployed individual may not be disqualified from receiving unemployment insurance benefits under Section 4 (a) (ii) of the Railroad Unemployment Insurance Act, as amended, if he fails to "bump" or displace an individual working on a job to which he has seniority rights greater than those of the occupant of the position, according to an opinion recently rendered by the general counsel of the Railroad Retirement Board.

The section of the Act to which the opinion refers provides that there shall not be considered as a day of unemployment for any employee "any of the 30 days beginning with the day with respect to which the Board finds that he failed without good cause, to accept suitable work available on such day and offered to him."

"It is clear," the general counsel points out, "that the disqualification did not apply unless the unemployed individual failed to accept work which was offered to him. Bumping, under seniority rules, does not, in the ordinary case, involve an offer; it involves the exercise of a right." He went on to say that an employee with greater seniority rights may exercise his right under rule of seniority to displace a junior employee, but seniority rules do not make it mandatory upon an unemployed individual with greater seniority rights to displace employees enjoying less years of railroad service. In his opinion, the right to bump is optional with the senior employees, who may exercise his privilege in accordance with his own judgment.

"An interpretation of Section 4 (a) (ii) of the Act which would compel one indi-

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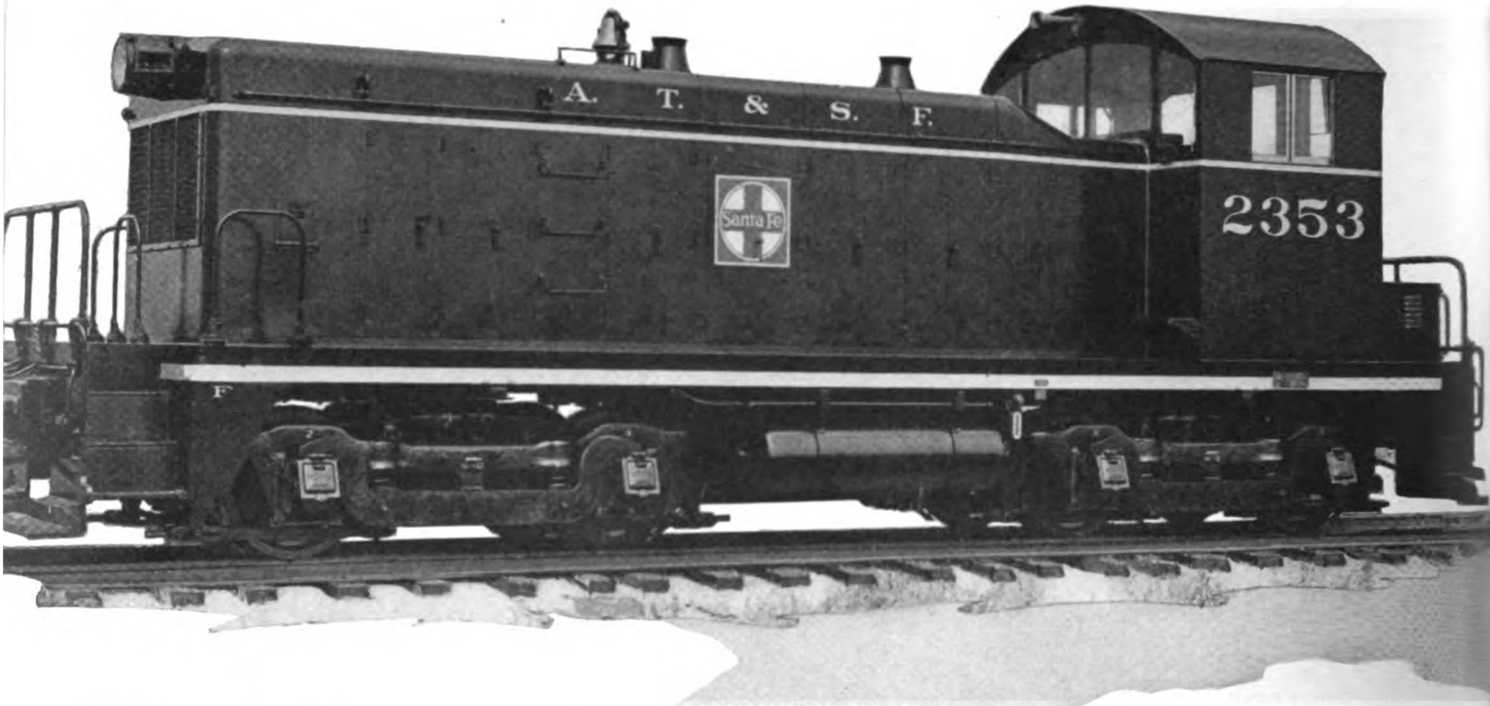
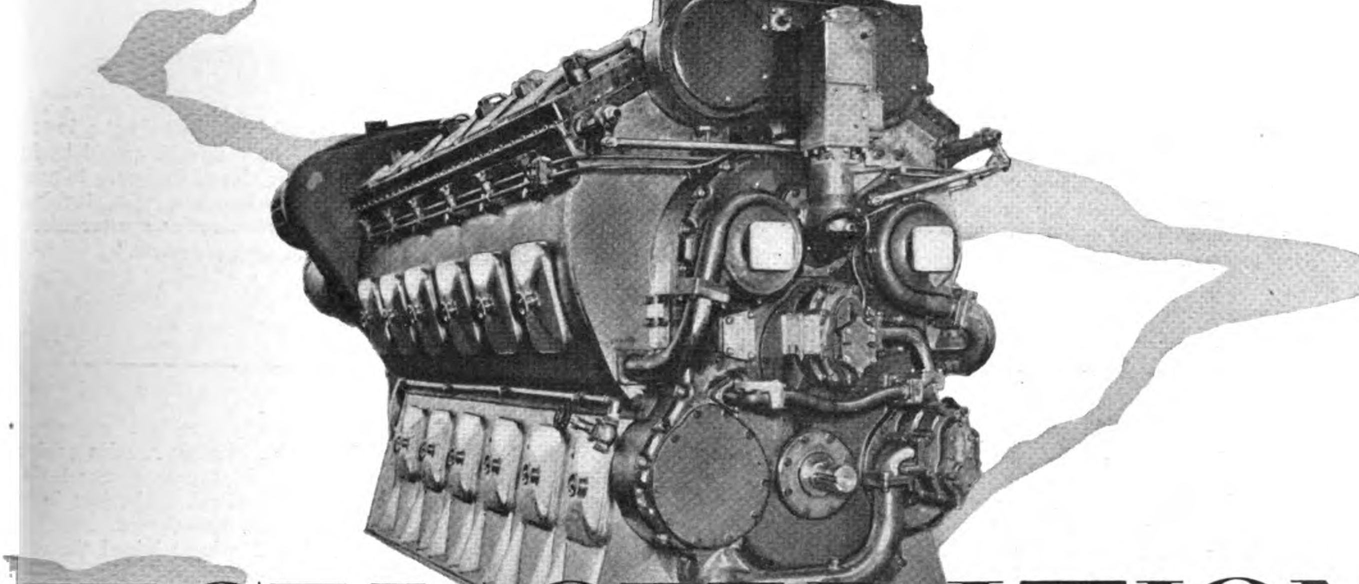


30% Increase in Availability—

EMC's HIGH availability average of 95 per cent indicates a more intensive utilization of power with fewer locomotives required to handle switching operations.

GM
GENERAL MOTORS
DIESEL POWER



DIESEL OPERATION

50% Decrease in Operating Expenses

PERFORMANCE records of over 250 EMC Diesel switchers in passenger terminal and yard service with close to two million hours of service on forty-two railroads prove beyond doubt that they are the most profitable motive power investment because they are reducing locomotive costs from 50 per cent to 75 per cent and frequently saving $1000 per month above carrying and amortization charges.

EMC Diesel operation reduces fuel expenses by 75 per cent, maintenance costs 50 per cent, enginehouse expenses 66 per cent, and water costs are eliminated entirely.

Dieselize with EMC and obtain all the benefits of safer, cleaner, quieter, and smokeless operation.

ELECTRO-MOTIVE CORPORATION

SUBSIDIARY OF GENERAL MOTORS   LA GRANGE, ILLINOIS, U. S. A.

vidual to displace another or suffer disqualification would result merely in the substitution of one unemployed individual for another," the counsel continues. "Such a result would be in conflict with one of the primary aims of unemployment insurance legislation and of the Act, that is, to stabilize or regularize employment in the industry. Furthermore, to interpret Section 4 (a) (ii) as disqualifying an employee for failure to displace a lower paid employee would tend to increase unemployment among employees in the lower paid brackets. Such a result would be in conflict with the aim of Congress to assist the lower paid employees, who, lacking seniority protection, suffer greater distress in a period of unemployment."

Supply Trade Notes

Avery C. Adams has been elected vice-president in charge of sales and a member of the executive committee and board of directors of the United States Steel Corporation of Delaware with headquarters at Pittsburgh, Pa. Mr. Adams succeeds C. V. McKaig, who becomes assistant to president, with duties as may be assigned. Mr. McKaig continues as a member of the executive committee and board of directors.

Avery C. Adams

Avery C. Adams was born at Youngstown, Ohio on December 15, 1897. He attended public and private schools and was graduated from Choate in 1917. He served with the United States Navy during the World War and was graduated from Yale University in 1920. Following his university training in metallurgy, he entered the steel industry and was until May, 1928, assistant general manager of sales for the Trumbull Steel Company. He was manager of the sheet and tin plate division of the Republic Steel Corporation in 1928, and later in the same year became sales vice-president and director of the General Fireproofing Company. He first joined the United States Steel subsidiary in June, 1936, as manager of sales, sheet division, Carnegie-Illinois Steel Corporation, resigning in December, 1938, to become vice-president and assistant general manager of sales at Chicago, of the Inland Steel Company. He now returns to the United States Steel organization.

◆

Charles L. Huston, Jr., assistant staff supervisor of employment at the Rolling Mill Company, Middletown, Ohio, has resigned, to become director of personnel of the Lukens Steel Company at Coatesville, Pa.

Howard B. Brown, who has been associated with the Pitcairn Company, has been elected secretary of the Pittsburgh Plate Glass Company, Pittsburgh, Pa., to succeed Carl S. Lamb, deceased.

◆

Thomas C. Gray has been appointed chief engineer of the Franklin Railway Supply Company, Inc., New York.

◆

George E. Scott has resigned as purchasing agent of the Missouri-Kansas-Texas to become vice-president and assistant sales manager of the Scullin Steel Company, St. Louis, Mo. Mr. Scott was born at Cleveland, Ohio, on May 27, 1885, and entered railway service in 1901 as a messenger boy on the Lake Shore and Michigan Southern (now a part of the New York Central) at Air Line Junction, Ohio.

George E. Scott

After serving as clerk to the assistant superintendent, secretary to the general superintendent, secretary to the assistant general manager and secretary to the vice-president, he resigned in 1912 to enter the employ of the Missouri-Kansas-Texas as secretary to the president. In the following year, he was promoted to assistant purchasing agent, and, in 1914, was appointed acting purchasing agent. In the same year, he became purchasing agent serving as such until 1918, when he also became purchasing agent of the St. Louis-San Francisco. During federal control, 1919-1920, he was also a member of the Regional Purchasing Commission, Southwestern Region. Since 1920, Mr. Scott has been purchasing agent of the Missouri-Kansas-Texas. He was chairman of the Purchases and Stores division of the Association of American Railroads in 1933, 1934 and 1935.

Wilson H. Moriarty, sales engineer of the National Malleable & Steel Castings Company, Cleveland, Ohio, has been promoted to sales manager of the Cleveland works. Mr. Moriarty joined the company in 1919, following graduation from Case School of Applied Science and service in the army. He was resident inspector at the East St. Louis, Ill., plant and later at the Chicago and Cleveland plants, subsequently becoming chief inspector for all plants. He has been in the sales department since 1931.

◆

L. T. Johnston, vice-president of the Armco Railroad Sales Company, Middletown, Ohio, has been elected president and general manager, and E. T. Cross, formerly general manager of the Ingot Iron Railway Products Company, whose railroad sales were taken over by the Armco Railroad Sales Company on July 1, has been appointed assistant general manager of the Armco Railroad Sales Company, with headquarters, as before, at Middletown, Ohio.

◆

The General Steel Castings Corporation, Eddystone, Pa., has opened a sales office at 310 S. Michigan avenue, Chicago. John A. McCormick, formerly sales engineer, is now district manager in charge of the new office. Frank B. Barclay, sales representative at Granite City, Ill., has been transferred to Chicago to assist Mr. McCormick. Mr. McCormick has been associated with the General Steel Castings Corporation and its predecessor, the Commonwealth Steel Company, since 1916. He served in the engineering department at Granite City until 1930, when he was appointed sales engineer at Eddystone, Pa.

John A. McCormick

William A. Ross, vice-president and general manager of sales of the Columbia Steel Company, San Francisco, Cal., has been elected president, to succeed Ambrose N. Diehl, who has resigned because of ill health. Mr. Ross has been connected with the steel industry since 1895, when he entered the employ of the Washburn Moen Manufacturing Company as an office boy. In 1899, this company was acquired by the American Steel & Wire Company, and Mr. Ross served the new firm as bill clerk and cashier. In 1911, the west coast holdings of the American Steel & Wire Company became the Pacific Coast department of the United States Steel Products Company, a subsidiary of the United States Steel Corporation, and upon this consolidation Mr. Ross was appointed assistant treasurer and later assistant to the vice-president of the products company. In 1930, the Columbia Steel Corporation was acquired by the United States Steel Corporation. The Pacific Coast department of the United States Steel Products Company was then consolidated with the new enterprise under the name of the Columbia Steel Company, with Mr. Ross serving as vice-president and treasurer. He was appointed vice-president and general manager of sales in 1932.

◆

Pedro C. Morales, formerly general superintendent of machinery and motive power of the National Railways of Mexico, has been appointed Mexican representative of Iron & Steel Products, Inc., Chicago, with headquarters at Chopo 24, Mexico, D. F., to succeed L. N. B. Bullock, resigned.

◆

Charles E. Webster has been appointed general manager of the Timken Roller Bearing Company, Ltd., Toronto, Ontario, with office at 55 Charles street, West. Mr. Webster has been associated with Timken Canadian activities for 20 years, his duties including the sales of Timken products throughout the Dominion.

B. H. Lawrence, chief engineer, has been elected vice-president in charge of engineering, United States Steel Corporation of Delaware, and member of its executive committee and board of directors.

◆

W. J. Stewart, sales representative of the transportation department of the Johns-Manville Sales Corporation, at Philadelphia, Pa., has been transferred to the southeastern territory, with headquarters at Washington, D. C., succeeding W. R. Bush, deceased. Mr. Stewart has been associated with the Johns-Manville Corporation for the past 20 years.

Obituary

Charles M. Schwab, chairman of the board of the Bethlehem Steel Corporation and who was known as "king of steel" since the opening of the century, died of coronary thrombosis, at the age of 77, on September 18 at his home in New York.

Charles M. Schwab

Mr. Schwab had been in ill health for some time. At 17, having completed his classroom schooling, Mr. Schwab swept out a grocery store in Braddock, Pa., daily and at 19, was chief engineer of the Edgar Thompson Works of the Carnegie chain of steel properties where he had started. He had been given a job as a stake-driver. By studying chemistry in a home laboratory, the young executive pioneered in the early stages of metallurgy as applied to the steel business, while, together with Captain Bill Jones, general plant manager of the Edgar Thompson Works, he introduced labor-saving devices to eliminate the crude process of steel manufacture then existent At 25, Mr. Schwab was superintendent of Andrew Carnegie's Homestead plant, one of the largest steel works in the country. Two years later he succeeded Mr. Jones as general superintendent of the Edgar Thompson Works. In 1892, his jurisdiction was extended to include Homestead, and in 1897, he was appointed president of the entire Carnegie Steel Co., Ltd.

In 1901 the United States Steel Corporation was formed with Mr. Schwab as president. He resigned, however, in 1903 to embark on the ambition of his life—the upbuilding of his own steel enterprise. In 1904 he organized the Bethlehem Steel Corporation. Our entrance into war saw him as director-general of the Emergency Fleet Corporation. After the Armistice, he decided to place Bethlehem in the hands of Eugene Grace (its president since 1916) and experienced associates. Mr. Schwab continued to advise as chairman but held firm to the principle of non-interference until his death.

◆

John Franklin Miller, until a few months ago vice-chairman of the board of directors of the Westinghouse Air Brake Company and an officer of other industrial organizations, died at Goshen, N. Y., on September 17, at the age of 80 years.

◆

H. H. Cust, who retired as vice-president, secretary and treasurer of the Mount Vernon Car Manufacturing Company in April, 1937, died suddenly on September 7, while on a visit in Dearborn, Mich. He was 80 years old.

Personal Mention

General

Alejandro Maurice has been appointed assistant general superintendent of locomotives of the National Railways of Mexico, with headquarters at Mexico City, D.F.

John C. Stump, assistant superintendent of motive power and machinery of the Chicago & North Western at Chicago, has been appointed superintendent of motive power of the Western district, a new position, with jurisdiction over locomotive and car matters on that district. His headquarters remain at Chicago.

Thomas F. Powers, assistant superintendent of motive power and machinery of the Chicago & North Western at Chicago, has been appointed superintendent of motive power of the Northern district, a new position, with jurisdiction over locomotives and car matter. His headquarters remain at Chicago.

Pedro de Leon, assistant superintendent of the Pacific division of the National Railways of Mexico, has been appointed to fill the re-established position of general superintendent of locomotives, at Mexico City, D. F.

Master Mechanics and Road Foremen

Guy S. Bennett, road foreman of the New York, Ontario & Western, has been appointed general road foreman and fuel supervisor at Middletown, N. Y.

W. L. Houghton, enginehouse foreman on the New York Central at Linndale, Ohio, has been appointed master mechanic on the New York Central, the Michigan Central, the Indiana Harbor Belt and the Chicago River & Indiana, with headquarters at Chicago, succeeding T. P. Ball transferred.

Car Department

A. S. de Castro, assistant chief inspector of air-brake and car-heating equipment of the Canadian National, has been appointed acting chief inspector of air-brake and car-heating equipment, with headquarters at Montreal, Que.

Shop and Enginehouse

H. E. Whitener has been appointed superintendent of shops of the Central of New Jersey at Elizabethport, N. J., succeeding C. W. Culver, retired. The position of works manager at Elizabethport has been abolished.

Obituary

Curtiss Day, general foreman of the Erie at Meadville, Pa., died on July 31.

The New BARCO

POWER REVERSE GEAR OPERATING VALVE

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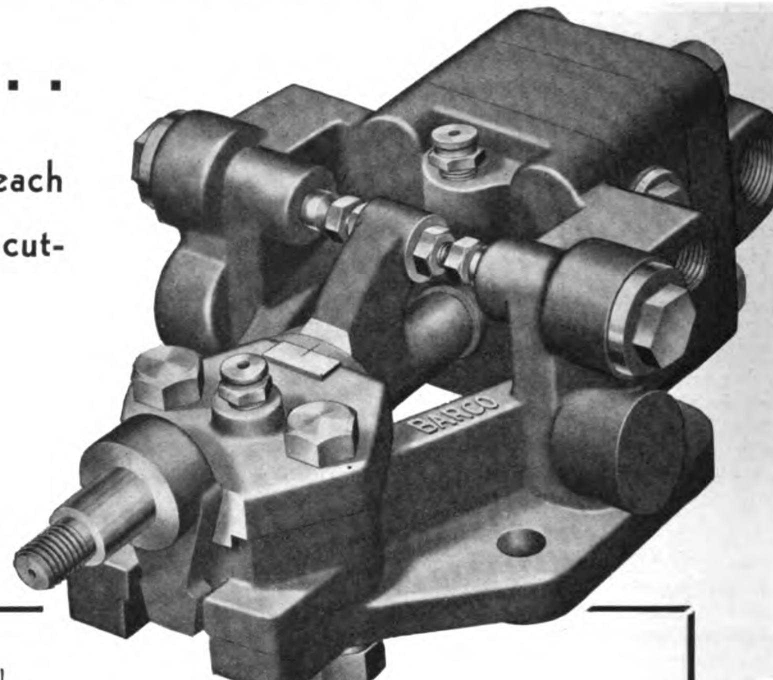
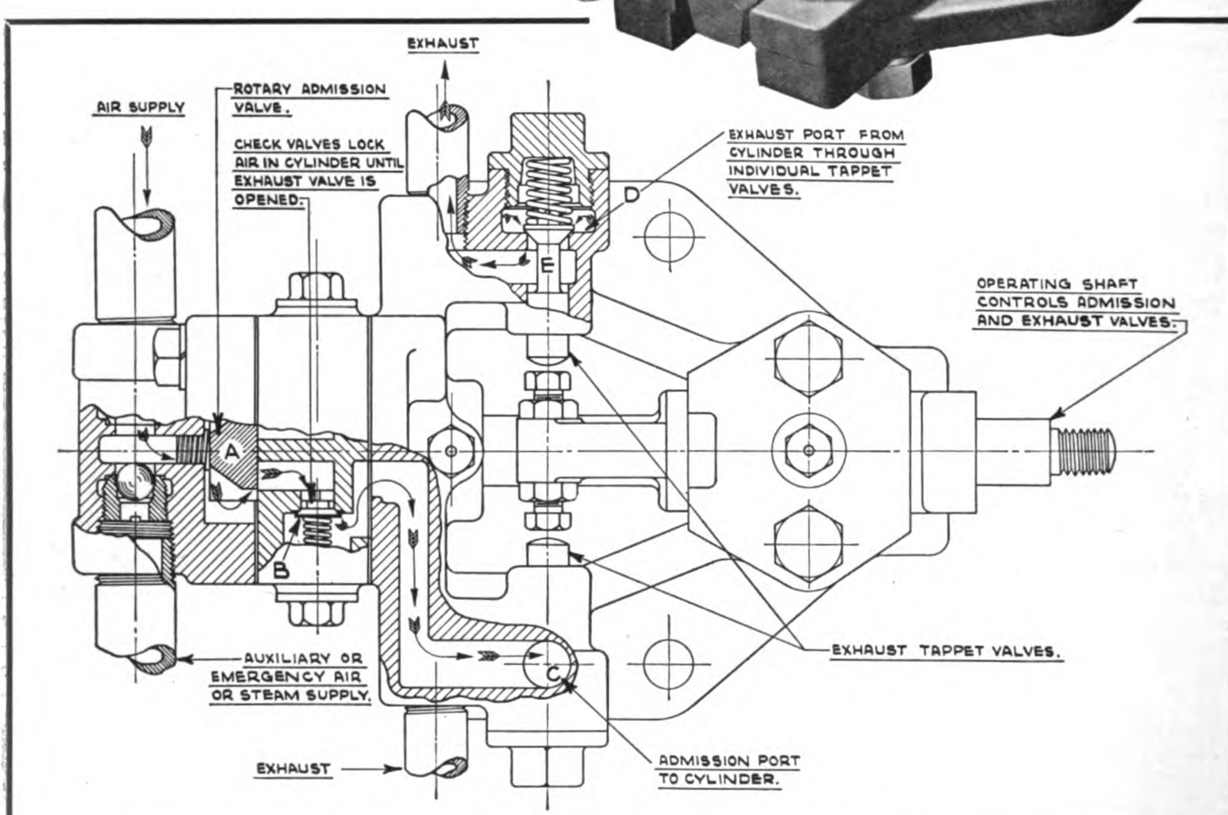
Same total pressure insured on each side of piston head — maintains cut-off accurately.

Cut-off position maintained even with broken air supply pipe.





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See page 503

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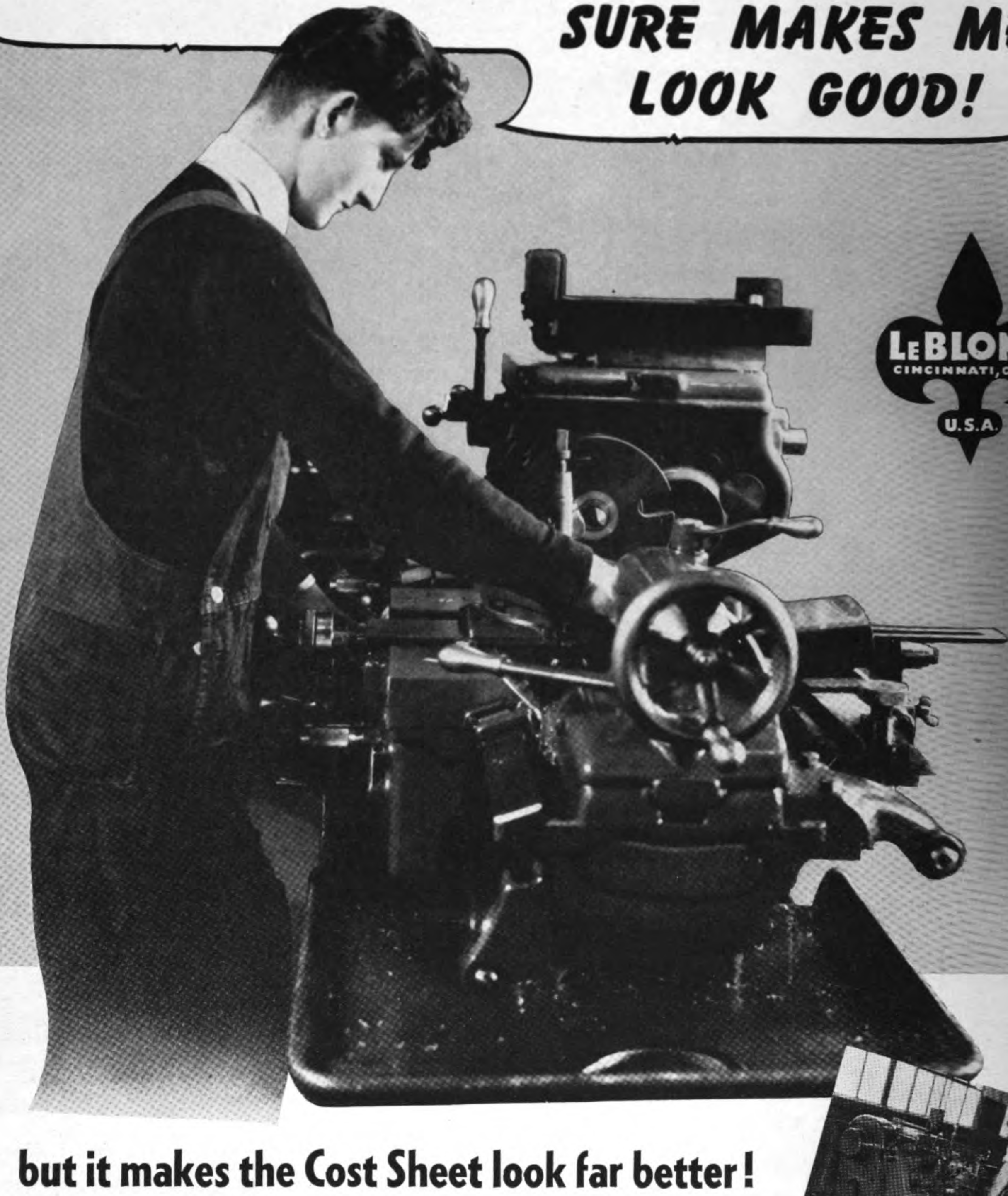

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Training Supervisors

L. W. Baldwin

Morale and fighting spirit depend upon qualities of leadership and railroads must have men properly equipped to direct the efforts of rank and file

At the joint opening session of the annual conventions of the Locomotive Maintenance Officers' Association, the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association and the Master Boiler Makers' Association, L. W. Baldwin, chief executive officer, Missouri Pacific delivered an address under the title, "Training and Coaching Supervision." An abstract of Mr. Baldwin's address follows:

Training and Coaching Supervision is a broad and most important subject and one deserving of the earnest study and thought of every railroad man interested in the continued advancement and success of the railway industry. I won't go so far as to say that the proper training of supervision is the most important factor in the success of railway operations, but I will say that it is one of the most important ones.

I am not a military man, nor even one with militaristic leanings, but I do know that the success of an army depends upon the quality of its leadership, and by that I mean not the generals so much as the captains, the lieutenants, the sergeants and the corporals, for it is up to them to keep up the morale, the fighting spirit and the efficiency of the rank and file. And it is the rank and file that wins wars, and, in the last analysis, determines the success or failure of any industry. Hence it is perfectly clear that a railroad, in order to attain top efficiency, must have men well equipped to direct properly the efforts of its rank and file—those who actually perform the proverbial thousand and one tasks that are necessary to keep the wheels turning, and to deliver the kind of service for which our American rail system is so justly famed.

The finest railway plant in the world would be of little value to those who invested in it or to the public it was built to serve if it were not manned by competent employees. The greater the competence of the men who operate it, the greater its value to those who have invested in it, and to the public. Now it is equally true and equally obvious that competence doesn't just happen. Men become competent through experience and through education. To my mind the old saying that experience is the best teacher borders on being a half-truth because it seems to have left the impression in the minds of many that experience is the *only* teacher, and that, of course, is not true.

There was a time when everyone who advanced did so because he had been a good pupil in the school of experience. Today there is no thoroughly satisfactory short cut that can be followed exclusively, and experience still is a necessary adjunct to success, but training and proper coaching have made the way not only easier but much more efficient. Today, thanks to training courses, to able teachers, constructive thinking and cooperative direction, it is possible for a man to become proficient in much less time than was required for him to obtain the same degree of proficiency in the days when only those who had learned their trade the hard way were considered worthy of leadership.

From that date a little more than a hundred years ago, when the first train laboriously chugged its way along a track, to the amazement of all—including probably its builders and sponsors—the history of railroading has been one of progress. There is not a man in this room who, if he will think back to the days when his name first went on a railroad payroll, cannot recall a steady procession of improvements and betterments. We who have devoted our lives to the railway industry find a strong fascination in our calling. We wouldn't be happy doing anything else. "Railroading gets in one's blood," is a rather often-heard expression. I think that is true, but I think it gets in our blood because in most of us there is a natural desire to have a part in

something that is vital, something that spells progress and service. We are proud to be known as railroaders because no industry has a finer, more inspiring and more impressive record of achievement, and this, too, in spite of the fact that in recent years, when it has achieved its greatest advancement, it has been confronted with its greatest difficulties.

Railroading Has Attracted Men of Vision

I think it can truthfully be said that the railroad industry has made its enviable record because it has attracted to it men with rare qualities of leadership, men of vision, men with a pride in their craft, and, above all else, men richly imbued with a zeal for service. It is men like these who constitute the real backbone of the railroad industry. From men like these have been chosen the captains, the lieutenants, the sergeants and the corporals of the great army of railroaders. They have been chosen as leaders because they possess certain qualities that enabled them to assume and to discharge responsibilities properly, because they knew their business and chiefly, in my opinion, because they had proved they had open minds.

No man can be a good leader of men who believes, or who even acts as if he believes that he knows all there is to be known about his task. Railroading is an industry of movement. Trains move today at a speed and with a dependability undreamed of a few decades ago. This was made possible by the combined efforts of countless men who continually sought new and better ways of doing their work. If railroaders, and particularly supervisors, had closed minds; if their eyes and ears were not always open to suggestions, and if there did not burn in them a constant desire for improvement, why then ours would, indeed, be a dying industry.

But the railroad industry is as far from being that as daylight is from darkness. It has had and is having its full share of trials and tribulations. It has been hammered and hampered by antiquated rules and regulations. It has suffered and is suffering from unfair and subsidized competition. But serious as they have proved, they have never dampened and will not dampen the inherent enthusiasm and determination of railroad men to progress—to find new and better ways of getting their work done and to better the quality of their service to the public.

The entire history of our railroading shows that change is as inevitable as death and taxes. As I have said, ours is an industry of motion. Like individuals, institutions and organizations of all kinds, the railroads must go forward or slip backward. There is no such thing as a standstill railroad any more than there is an individual who, over a period of years, does not either become more efficient or less efficient.

This fact makes heavy the responsibilities of railroad officers and their assistants, the supervisors, for it is, of course, their duty to see that this progress is not only continued but accelerated. And that brings us face to face with the problem of training and coaching supervision. For one thing, I think it should be brought home to each supervisor that if he does not devote at least a part of his time to study, planning and thinking he cannot be very successful in his efforts to inspire his men to greater efficiency and greater loyalty.

Efficient Supervision of Work Not the Only Requisite

In this day when success is so utterly dependent upon efficiency it is quite clear that no supervisor can be content with merely seeing to it that his men turn out a specified amount of work. As I have said, tremendous forward strides have been taken in all branches of railroading but there are still vast improvements to be made, new ideas to be thought out, developed and perfected, new economies to be considered and adopted. No one has a monopoly on ideas and it is part of the supervisor's job to work with and to co-operate with his men so that they will be thinking along new and progressive lines.

This cannot be done except through the maintenance of proper relations between supervisors and the rank and file, and I think the supervisor who allows himself to lose touch with his men is overlooking a major requisite to his own advancement and is not getting the best possible results from them. Naturally this same observation applies with equal force to contacts between officers and their supervisors.

What we know as "good organization" depends upon the extent to which officers keep in close touch with their supervisors and upon the supervisors maintaining close personal relationships with their men. Good organization means a complete understanding by everyone of what is to be accomplished, the manner in which it is to be accomplished and perfect co-ordination of both effort and knowledge.

The matter of proper co-ordination is a most important one and should, I think, be emphasized in all coaching of supervisors. A supervisor may be outstanding in the handling of his men, he may get from them the best possible co-operation and produce satisfactory results, keep his costs down and his records in perfect shape, and do all of the other things that are expected of him, but still be a failure as a supervisor if he loses sight of the organization as a whole and regards the operations of his force as something separate and apart from other forces.

The modern railroad is the most perfect example of big scale co-operation ever developed. Any individual who forgets for a moment the absolute need for and value of co-operation is not properly filling his niche, or living up to the traditions of our industry. Co-operation, however, is dependent upon understanding and the responsibility for bringing about a proper understanding on the part of the supervisors, and developing and maintaining in them a proper attitude toward their duties and their responsibilities calls for careful and painstaking coaching. In my opinion, this cannot be done by writing out instructions, by issuance of bulletins or in any way except by personal contact.

Coaching of supervisors should not be confined entirely to matters relating directly to better shop practices, better co-operation between forces or other phases of the actual work. It should also include efforts to bring about a better and more thorough understanding of the railroad situation and a greater sense of responsibility on the part of all employees to do all they can for the benefit of the industry in general, and for their own railroad in particular.

It is inconceivable that a man who works for a railroad and who knows that railroad employment and railway revenue have been constantly declining could maintain an attitude of indifference concerning the decrease in railway business, or of the causes that are responsible. And I firmly believe that if there is an employee on any railroad who seemingly is indifferent to the situation, it is because someone in an official or a supervisory capacity has failed to take the time and trouble to acquaint him thoroughly and definitely with the facts.

An aroused and active army of railway employees, standing shoulder to shoulder, and fighting earnestly and sincerely for legislation that would eliminate handicaps

(Continued on page 502)

Constructive Reports Presented at Meeting of

Master Boiler Makers

Apprentice training, renewal of fireboxes, circulation of water, feedwater treatment, and welded construction of tender cistern were some of the subjects included in the program

A TOTAL of 165 members of the Master Boiler Makers' Association, over 50 per cent of its membership, registered at the twenty-sixth annual meeting at Chicago on Oct. 17, 18, and 19. The president, W. N. Moore, general boiler foreman, Pere Marquette, opened the meeting with a brief address of welcome.

The address by Roy V. Wright, editor, *Railway Mechanical Engineer,* was the first of several stimulating addresses and lectures by railroad and government executives. Among the speakers were D. S. Ellis, chief mechanical officer, Chesapeake & Ohio; F. K. Mitchell, assistant superintendent of equipment, Cleveland, Cincinnati, Chicago & St. Louis; J. M. Hall, chief locomotive inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission; M. M. Hanson, principal field representative of the United States Department of Labor, Federal Committee on Apprenticeship. Lectures were delivered by Dr. W. C. Schroeder, senior chemical engineer, United States Department of Interior, Bureau of Mines, on the Causes and Prevention of Embrittlement in Locomotive Boilers*; and by C. M. Rogers, Locomotive Firebox Company, on Circulation of Water in the Boiler, which included a showing of motion pictures.

Eight technical reports were presented during the meeting. Among these was a report submitted by committee chairman, F. A. Longo, welding and boiler supervisor, Southern Pacific, on the renewal of fireboxes. An abstract of this report will be published in a later issue.

The Election of Officers

The following officers were elected to direct the activities of the association during the coming year: President, C. A. Harper, general boiler inspector, Cleveland, Cincinnati, Chicago and St. Louis, Indianapolis, Ind.; vice-president and chairman of the executive board, C. W. Buffington, general master boilermaker, Chesapeake & Ohio, Huntington, W. Va.; secretary-treasurer, A. F. Stiglmeier, general boiler foreman, New York Central, Albany, N. Y.; executive board members, C. J. Klein, locomotive inspector, Interstate Commerce Commission, Albany, N. Y.; E. E. Owens, general boiler inspector, Union Pacific, Lincoln, Neb.; F. A. Longo, welding and boiler supervisor, Southern Pacific, Glendale, Cal.; R. W. Barrett, general boiler foreman, Canadian National, Stratford, Ont., B. C. King, general boiler inspector, Northern Pacific, St. Paul, Minn. The following continue as members of the executive board: M. C. France, general boiler foreman, St. Paul, Minneapolis and Omaha, St. Paul, Minn.; L. R. Haase, district boiler inspector, Baltimore and Ohio, Baltimore, Md.; and E. C. Umlauf, supervisor of boilers, Erie, Susquehanna, Pa.

* An abstract of this lecture will be published in a later issue.

Carl Harper
Vice-President

W. N. Moore, President

A. F. Stiglmeier
Secretary-Treasurer

How the Association May Better Serve the Railroads

By F. K. Mitchell

Assistant Superintendent of Equipment, Cleveland, Cincinnati, Chicago and St. Louis

Your association came into being in 1906 when the old Master Steam Boiler Makers' Association and the International Railway Boiler Makers' Association were consolidated, and your first regular convention was held in 1907. At that time there was a crying need for such an organization. Boiler design and maintenance was indeed a crude and primitive art. A boilermaker was just a necessary evil and his standing among railroad employees was near the bottom. There were no federal laws covering the construction, inspection and maintenance of locomotive boilers and their appurtenances. There was no serious regard for the safety of the employees building, operating, or maintaining them. Tools, material, machinery and personnel were inadequate, methods crude, and the performance of the boilers in service was no better than such conditions could be expected to produce. The problems of the boiler supervisor must have seemed almost insurmountable—he had nothing but criticism from all sides, no place to go for advice, and no way of knowing how the other fellow was meeting similar problems. Under such conditions something had to be done, and the creation of the Master Boiler Markers' Association was one of the most important steps toward the solution.

Introduction of New Ideas—Real Battle

The minutes of your conventions are a saga of railroad operation and maintenance improvement, as interesting as any story ever written. Yet even they do not reflect the real battle which has gone on. I know a little of what this battle has been, because of the fact that it has been my privilege for a good many years to be associated quite intimately with one of your members, whom I consider to have no peer as a boilermaker and a boiler supervisor. For hours I have discussed with him the problems of boiler work peculiar to our road and have spent days with him inspecting boilers and fireboxes and examining boiler inspectors. He has given me freely of his knowledge of boiler work and I have profited thereby, as no doubt many a fellow employee of each of you has done on your respective roads. I have shared with him his pleasure in seeing his ideas or ideas brought back from your convention prove astoundingly successful and his disappointment at not being able to put over other ideas. Everyone of you, no doubt, has had the experience of going back to your immediate supervisor with an idea which you knew full well to be sound that would result in economies and yet you could not put it over because it was going to cost something to do it. All too often improvements and new ideas had to be accomplished in spite of your superior officers and not by reason of their co-operation.

Valuable Assistance by Supply Group

Whether you appreciate the fact or not, one of your greatest allies in this endless battle has been your supply members and friends. They have gathered here with you, heard your problems, and putting their resources and engineering staffs to work have developed tools and machinery to produce a solution. Furthermore, they have been able in many cases to sell ideas to your superior officers where you yourselves could not. True enough, in some cases their motives may have been largely mercenary, yet in the main where they have profited, the railroads have profited to a far greater extent. Regardless of how your achievements may have been won, whether by direct contact and the co-operation of your immediate superiors, or through other channels, the fact remains that you are one of the most important factors in bringing locomotive operation and maintenance to its present high standard.

Twenty-five years ago boiler and flue failures were the bane of any superintendent of motive power's life and every time he analyzed his maintenance costs he invariably found that boiler work and boiler washing were responsible for his poor showing. Today, if he could keep his other failures down to the standard established for boiler and flue failures he would be happy and furthermore, he no longer finds that boiler maintenance and related costs are the big item of his expense. You have, in a large measure, taken that worry off his mind.

Enough has now been said as to what you have so far accomplished. You all appreciate that the job will never be done. New and complicated problems arise daily and will continue to do so. You must and will carry on.

Association Makes No Recommendations

How can an organization which has accomplished so much good, become more useful and more nearly accomplish its ideals? A cold analysis of this subject leads me to the conclusion that your success thus far has been because of the high quality of your membership and not because of the character of your organization. In other words, you are functioning far better as individuals than you are as an association.

To point out more clearly what I am driving at, let us assume any one question as to boiler maintenance or construction, and ask what the Master Boiler Makers' Association thinks about it or recommends in connection with it. The only answer you can possibly get is that the association neither thinks nor recommends anything. Its individual members have good ideas and recommendations to make on any subject with which they are individually familiar, but the association does not. Study the proceedings of any of your conventions and you will have to come to that conclusion. Any volume of these proceedings carries fine papers on many important subjects but, in the last analysis, these papers represent the individual opinions of a few of the members who have been either on the committee assigned to prepare the paper, or in some cases other members who have been consulted by the committee. In addition, there may be some further light thrown on the subject by discussion from the floor, but you will not be able to tell what the association, as a whole, thinks of the subject or would recommend as a solution to the problem.

Perhaps you have in the past taken the wrong, or too narrow interpretation of one little word found under the caption "Object" in your constitution and by-laws. I quote that part of your constitution and by-laws in full: "Object: The object of this association shall be the mutual improvement of its members by an exchange of ideas in meetings, the reading and discussion of papers and a general interchange of views so that all may profit by the experience of others more proficient in our Craft."

That in itself is a noble ideal which has been, in the

past, a radio beacon directing you toward your goal. If the word "all" were interpreted to have been intended for use in the larger sense to mean every man or group engaged in the craft or affected by your efforts, and not to refer to the membership alone, what a different goal this beacon would be leading you to.

Consider what it would mean to apprentices, prospective boiler foremen, boiler foremen, supervisors of boilers, master mechanics, superintendents of motive power, and even to engineers of motive power and locomotive boilers, to have the consensus of opinion of the membership of an association of this kind available for their information and guidance. Furthermore, think what it would mean to your prestige as an association.

Full-Time Secretary Required

The setting up of Recommended Standards of Practice for even boiler maintenance would entail a large amount of work and expense but, I say to you, such a set of standards for both maintenance and construction would be well worth any effort and expense involved. Naturally the question arises as to how this can be accomplished.

To begin with, the services of a full-time secretary would be required. Also a limited full-time clerical force. Questionnaires on many already well established maintenance practices could be sent to the membership (one with voting power on each railroad) in a short time, reserving the more complicated and less well established practices in maintenance until later, and not attempting any recommendations on boiler construction until the maintenance standards were well along. These questionnaires would have to be tabulated and either accepted as standard or rejected for another vote on the basis of a predetermined majority requirement.

It is an evident fact that the character of the secretary obtained would in a large measure decide the success or failure of such a plan. Your secretary, to handle such a job, should be of the highest calibre and paid an annual salary which would enable you to hold him.

To defray the expense of such a man and his necessary office force and expense, might require some such plan as the sale of sustaining memberships to each road and perhaps among supply companies for an annual payment. It is possible, however, that after the process had gone on for some time your standards could be printed in loose-leaf form (with a provision that they would be kept up annually) and sold in sufficient quantities to entirely defray the expense involved.

It is a regrettable fact that some such procedure as outlined above was not instituted by your association long ago so that such valuable information might be available at this time, yet it is not too late to start and the end will well justify the means.

So gentlemen, I am offering you these suggestions for what you may consider them worth. A good which is worth accomplishing is worth making permanent. As Shakespeare so aptly said—"The evil which men do lives after them—the good is oft interred with their bones." This may be a way of preventing one such interment.

Association Benefits to the Railroads and Its Membership

By D. S. Ellis

Chief Mechanical Officer, Chesapeake and Ohio

Since time immemorial it has been the custom of humans to band in groups or associations, originally in self defense and for the protection of their mutual interests. As the defensive need for such organizations lessened through the years, it became apparent that their continuance could be made increasingly valuable through co-operation and the exchange of ideas on matters of common daily interest. Further in their evolution it was found, particularly in the case of supervisory organizations such as yours, that, while the interchange of technical as well as practical ideas and improvements was particularly beneficial to the membership in promoting individual efficiency, their ultimate value lay in their liaison position between supervisor and workman, and in their ability to help the individuals create a true spirit of mutual dependence and harmonious relationship, one with the other. It is this thought that I particularly wish to emphasize today because I feel safe in saying without fear of contradiction or challenge from both a technical and a practical standpoint, that the value of your organization is so well recognized that there is no need for further elaboration.

Success of Railroads Depends Upon the Men

From the railroad side, I am more impressed each day with the fact that beyond all else their success is largely dependent on the attitude of the men, especially those represented by this gathering in a supervisory capacity. The great and varied facilities on our railroads, in order to function efficiently and satisfactorily, must be guided and controlled by honest, earnest and capable human agents. Bearing this in mind and assuming that the railroads are properly located and equipped, it obviously follows that the human factor is of utmost importance in helping the railroad industry to rise and move forward in the favor of the public from which its business must be derived.

This, then, is a matter of having the proper organization, interested in making this accomplishment possible. This can only be effected by each individual doing his entire duty in his appointed place. Work performed in pursuance of this principle is not the result of hazard—it is done so because some supervisor or group of supervisors has studied and planned; planned in the interest of economy and expedition and with due regard for the safety and welfare of all concerned. It is here that the supervisor of today can do most to engender cordial relationship, one to the other. By that I mean—if work is properly studied, analyzed and planned beforehand, it can be pursued to completion with a minimum expenditure of effort to the employee who has the knowledge and satisfaction of a job well done, and with the minimum expense to his company. No one has a greater opportunity to be as important a factor to his employer's business or in his employees' welfare than the foreman in the mechanical departments of our railroads; and this is particularly true in the case of the members of this organization, who handle the maintenance, repairs and building of the largest and most important single part of the steam locomotive—its boiler.

Association's Value to Railroads

The foregoing is the gist of the message I am attempting to bring to you today. I could go into much more

detail but the fact would still remain that each supervisor has his own particular problems to cope with and these can only be met by personal experience, constant analysis and planning, as well as through the benefit of contacts with members of organizations such as this which enable him to profit by the experience of others.

If in the future as in the past the work of your organization continues to unearth and uncover undesirable practices both in construction and maintenance and you continue in the future as you have in the past to discuss all of your problems at such gatherings as this, and you can together put into further execution my thoughts as expressed to you today, the benefit of your mechanical association to the railroads and to our membership will be of such high value and great help that your importance to the industry which we represent will speak for itself and stand as mighty as the oak. Most of the thoughts expressed to you here today are not new but such truths will always bear repetition, and my sole purpose in repeating them to you is that they may renew and intensify sympathetic consideration of the problems that face each one of us, and always temper our judgment and decisions with the truth, and above all, the Golden Rule.

Successful Supervision An Art

By Roy V. Wright

Editor, *Railway Mechanical Engineer*

In the first place, let me congratulate you heartily on the truly remarkable record that your association has made. Throughout your life of more than a quarter of a century, and particularly under the trying conditions through which you passed in the 30's, you have fought loyally and progressively to advance your profession in the interests of more effective and more economical railroad operation. Exhibits and conventions might be cancelled, but you went determinedly forward getting out your proceedings in one form or another every year. You have maintained a high standard of constructive and helpful reports and discussions. In the days to come, as you look back on these difficult years, you can well afford to be proud of your performance.

The problem of the master boilermaker has been made more difficult because of the rapid advances that have been made in design and construction and in the materials used. Many of you have been in the boiler department during the entire life of this association. It is interesting to note the remarkable changes that have taken place in this momentous period, which have made necessary radical modifications in boiler department practices and have greatly increased your responsibilities. As I have studied your progress and have watched the activities of your association, I have marveled at the way in which you have met these challenges, and at the type of practical and technical material you have brought out in your conventions.

Training in Personnel Work Important

I am wondering, however, whether a greater amount of emphasis should not be placed upon the human problem in the boiler department. Two years ago Mr. Moore, who was then your president, made the following statement, which was repeated in an address made by Dexter C. Buell on the training of boilermaker apprentices: "The outstanding need in the successful operation of the boiler department today is not tools, equipment or machinery; it is men, or rather young men—apprentices who are sufficiently interested to be developed in the fine arts of the trade."

There is no question but what the boilermakers' trade has been steadily advancing to higher standards of performance and that in all probability still further advances will be made. An ample supply of well trained young men is necessary to provide for the future, and too great emphasis cannot be placed upon the importance and necessity of this. I feel strongly, however, that something further is needed, which in the next few years may be of even more vital import.

The state of the art is advancing and the demands upon the locomotive boiler are growing, but what are we doing along educational lines to train and equip the present boilermakers better to meet these demands and requirements? Or, going a step further, what are we doing as master boilermakers to keep in touch with the latest development in personnel administration, in order that we may more effectively select and coach men who will be advanced to supervisory positions in the days to come? What, also, are we doing as supervisors to take advantage of the latest ideas and the best practices of dealing with the workers?

Successful Foreman—Or Hard-Fisted Driver?

Successful supervision is an art—a steadily progressing art, for it is not so long ago that the successful foreman was too generally pictured as a hard-fisted driver. That day has passed, although there are still some hangovers of the old type who have failed to recognize the passing of the old regime. This change in the attitude of supervision was, in most instances, not engendered by any emotional wave of sympathy for the men in the ranks, but rather because of recognition of the fact that better results can be obtained by dealing with the human factor in industry on a more intelligent and scientific basis.

Whereas at the turn of the century attention was concentrated upon machinery, equipment and materials, and the importance of the human factor in production was largely overlooked; that attitude began to change when we entered the mass production period early in the century and the whole problem of production was subjected to scientific analysis.

In the past four decades an entirely new vocabulary has been developed, so far as industry is concerned. If anyone had used the expressions, "personnel administration" or "psychology and industrial efficiency" 40 years ago, they would hardly have been understood, at least so far as industry is concerned. Now personnel departments in industrial organizations are the rule rather than the exception. This has been reflected in the relation between the workers and the foremen, as well as between the foremen and the managements, and has developed an entirely new philosophy, so far as human relations in industry is concerned.

Effect of Mass Production

This is not to be wondered at, when certain other facts are taken into consideration. Watts' steam engine was perfected in 1776, the same year in which the Declaration of Independence was signed. It was a long,

tedious process, however, to develop machine tools and facilities which would make possible the building of an efficient engine. Moreover, before it could be applied effectively in industrial operations, means of transportation has to be devised to afford economic justification for manufacturing plants of large size. Raw materials had to be brought to such plants, and ways and means had to be devised to distribute the products economically over wide areas.

It was not until well after the beginning of the present century that the more intense or mass production era began in this country. What that has meant in upsetting traditions and bringing about radical changes in our economic and social life may be partially gaged by the fact that according to a statement by President Karl T. Compton of the Massachusetts Institute of Technology, our productive capacity in this country has increased fifty times in the past four decades. Speaking before the Society for the Promotion of Engineering Education at its annual meeting last June, he said: "We know . . . that the people of the United States are served by the energy equivalent of 100 slaves working 12 hours a day for each man, woman and child, and that this achievement in energy production has been attained with amazing rapidity. At the turn of the century, the power used in this country was approximately equivalent to two man-power per capita."

One notable fact in the depression through which we have been passing is the emphasis that has been placed on research by industrial organizations. There is marked evidence of this in the locomotive boiler field, not only in better materials, but in design, the auxiliaries, and the methods of fabrication. Some of these improvements are now coming into general use.

The Challenge

A two-fold problem and challenge, therefore, faces the supervisors in the locomotive boiler departments: (1) to keep in step with the demands being made upon them by the improvements in boiler construction and fabrication, and (2) to take advantage of the best thought and practices in the art of supervision. Of these two, the human relations problem is by no means the less important.

The Work of the Bureau of Locomotive Inspection

By J. M. Hall

Chief Inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission

The basis of life on this continent is mass transportation, the sort of transportation that only the railroads are equipped to handle. No industry has contributed more to the advancement of civilization than the railroads, and you may take just pride in doing a man's share in this mighty task.

Boilers have often been referred to as the heart of the locomotive. It may not be amiss to refer to them as being the stomach as well because they take in and consume enormous quantities of fuel and water, much of which is converted into useful energy making possible the hauling of trains, light or heavy, fast or slow, as the nature of the service demands. The dependability of this service rests on your shoulders, but it may not be necessary to tell you this because you hear about it in no uncertain terms whenever one of your locomotives fails from any cause that may be within your control. Due to your skill and earnestness of purpose such failures are rare today. When we compare locomotive performance now with that of a comparatively few years ago we cannot help but marvel at the progress that has been made in the reliability of locomotive boilers and the manner in which they stand up to their task under today's grueling service.

In the early stages of enforcement of the Boiler Inspection Law, which was later amended to include the entire locomotive, opposition on the part of the railroads was often encountered. It is only fair to say, however, that it was usually found that this was largely due to lack of authority on the part of the local railroad officers to hold locomotives when they should be held for repairs, or lack of proper organization or necessary appropriation to properly perform the needed work, rather than to innate objection on the part of the mechanical officers to having their locomotives maintained in good condition. This situation became better as time went on as the railroads gradually came to realize that vast economies could be effected in maintenance costs through the medium of thorough inspections and timely and proper repairs and that true economy and promotion of safety by keeping their locomotives in serviceable condition go hand in hand. This changed attitude was contributed to in no small measure by your organization and by individual members thereof.

Improvement in Condition of Boilers

The necessity for the law was brought about by the general practice on the part of the railroads of subordinating the making of needed repairs to the requirements of convenience. Practically all the large railroads had inspection and repair rules that were more or less adequate but these rules were generally considered as being merely expressions of desirable practices and little if any attempt was made to apply substantial repairs if any inconvenience would be caused thereby. As a consequence of this policy, ineffective or temporary repairs were often applied or the locomotives were continued in use with known existing defects until failures, many of which resulted in deaths or injuries, occurred.

Our early inspections disclosed that locomotive boilers were being operated with practically every defect that could exist in a neglected boiler.

During the first year there were three boiler shell explosions in which 27 persons were killed and 41 injured and 94 crown-sheet and firebox failures in which 54 persons were killed and 168 injured. The number of locomotives ordered withheld from service by our inspectors for necessary repairs was 3,377. In addition, 3,591 boilers were required to be strengthened or changed to comply with the requirements of the law and rules or permanently removed from service.

In 1938 there were five crown-sheet failures in which five persons were killed and three injured; the number of locomotives ordered withheld from service by our inspectors for all causes, including defects in machinery, was 679.

It might here be emphasized that the purpose of the law as expressed in the title is to promote the safety of employees and travelers upon railroads. To promote safety means to advance, extend, elevate, or contribute

to the growth of safety. This contemplates continuous progressive improvement; it calls for additions or changes whenever advancements may be made, and conversely, it prohibits the use of locomotives or parts thereof, or processes of assembly or repair which may be inferior, or upon which there is any doubt as to their being of at least equal integrity to practices already established.

Responsibility

The locomotive inspection law and rules are very specific in placing responsibility upon the railroad company for safe construction, the making of inspections, and maintaining locomotives in proper condition and safe to operate without unnecessary peril to life or limb. Yet it is not uncommon to be asked by a responsible representative of a railroad company for acquiescence in the use of locomotives on his individual railroad of practices long recognized as unsafe.

Another procedure that is sometimes followed is to apply parts or appurtenances, or make repairs, in a manner that cannot be justified from the standpoint of safety, and then, after placing in service and having attention called to the condition, attempting to obtain rulings or interpretations that will permit use ostensibly within the legal requirements. Such attempts are usually accompanied by the pretext that it would be expensive to remove the locomotives from service and make changes, that the parts or appurtenances or method of repairs are less costly than recognized conventional standards, and by the suggestion, if not argument, that the changes are advancements in the art, when, in fact, similar, if not identical arrangements have long since proved themselves to be unsafe. We are not believers in the axiom that "there is nothing new under the sun," but it would seem that there is considerable truth in this old saying as such practices are indulged in not only by those who may have little knowledge of the ruggedness and dependability necessary to insure safety in railroad equipment and who probably are not familiar with what has heretofore been tried and discarded, but also by others who should be in a position to realize that attempts to use parts or appurtenances, that may reduce the degree of safety now afforded, are not in line with real progress.

Progress—Or Safety?

Every generation has its own interpretation of progress. However, I am not sold on the idea that the desire to progress permits us to cut corners on matters of safety without giving due weight to the fact that taking a chance is keeping open house for death. The attitude of the Bureau of Locomotive Inspection is not ultra conservative; however, our responsibilities in seeing that the purpose of the law and rules is accomplished are too great to permit us to acquiesce in, or condone, the use of equipment that would reduce the degree of safety now afforded. There is danger in brushing aside things that have been proved in the past to be good and fundamental and seeking to adopt new, and in many cases, wholly untried ideas without need or justification. This is said with a full understanding that the trial and error method is the only means of bringing any new idea to perfection, but at the same time bearing in mind that most any new idea is susceptible to a calm analysis which will reveal its probabilities with respect to safety.

The duties imposed upon the railroads by the law are absolute and continuing. The fact that a Federal inspector has not taken exception to a condition, method of inspection, or method of repair, does not relieve the railroad from the responsibility placed upon it as clearly established by court decisions.

It is the purpose of the daily, monthly, and annual inspections required by the locomotive inspection law and rules to detect weaknesses that may have been unintentionally or thoughtlessly incorporated in construction or when making repairs, and to disclose deterioration that inevitably develops in service. If failures or train delays must be had, the proper place to have them is at the terminal where safe and economical repairs can be made.

The words, "economical repairs," are not here used in the sense of cheapness—there is no exemption from admission charges to the realm of dependable performance and service. However, there is a rebate on these charges that is recovered as time goes on. Economical repairs are substantial and consequently cost more money at the time they are applied than the inferior work that always accompanies cheapness. The difference resolves itself into the fact that economical repairs are in the long run low-cost repairs because they are lasting and pay a dividend in the shape of superior all-around performance, while inferior repairs result in consistently poor performance and are a continual source of expense and danger.

Purpose of the Bureau's Work—Future Assistance by Master Boiler Makers

The Locomotive Inspection Law is humanitarian in its purpose; it was designed to conserve life and limb. There has been practically a steady reduction in the number of accidents, number of persons killed, and number injured, each year since the law became effective.

Bare statistics cannot, however, give an adequate picture of the human suffering that has been avoided through enforcement of the law. Perhaps I should not use the word "enforcement" in speaking to Master Boiler Makers because the word implies some element of compulsion and there has been little if any occasion so far as your members are concerned to use the punitive measures provided for in the law to obtain compliance; your cooperation has been of an order seldom received by the administrators of any law.

In addition to the humanitarian aspect the operation of the Locomotive Inspection Law has also had a far reaching economic effect since it served to bring to the railroads a realization that vast savings in the ultimate cost of repairs and in unit fuel consumption are made possible by maintaining their locomotives up to the standard contemplated by the law and rules.

The assistance that can be given by the Master Boiler Makers Association and its individual members in the future will, of necessity, be along the same general lines as that given in the past. Of course, each of you will continue to make intensive studies of your most pressing problems, discuss them with other members, and, if of sufficient general importance, the results of your studies and experiments will be presented at your conventions so that all may profit thereby. This is a real service as your published proceedings make your deliberations available to all who wish to profit by their contents, and as great confidence is placed in the recommendations of your association, care should be exercised in sponsoring only the best practices rather than proposals of debatable value, in order that the prestige of your organization may be maintained. Then, too, the inevitable fact should not be overlooked that in the natural course of events some of the men now under your jurisdiction will take your places and younger men will in turn take their places. The training of these men in proficiency and the upholding of the best traditions of your craft is part of your work and should be given your thoughtful attention.

The Functions of the Federal Committee on Apprenticeship

By M. M. Hanson

Principal Field Representative, Federal Committee on Apprenticeship, United States Department of Labor

The preparation of skilled workers under sound standards of apprenticeship is one of the most important and significant problems facing management, labor and government. It is universally recognized that a skilled worker can be fully and properly developed only through actual performance of the work of the trade on the job. Therefore, if young workers are to receive adequate preparation in all of the processes of the trade, there must be standards established to serve as yardsticks covering all aspects of apprenticeship. These standards should be worked out with representatives of management and labor, with the assistance of federal and state labor departments.

During the past two or three years there have been a number of significant developments with respect to the preparation of skilled workers which has encouraged closer cooperation of labor and employers. These developments have also given state and federal labor departments responsibility for the establishment of apprenticeship labor standards.

Significant among developments is the acceptance by the U. S. Congress, the U. S. Office of Education and the U. S. Labor department of the principle that the promotion of labor standards of apprenticeship is a function of departments of labor. As a result, the work of the Federal Committee on Apprenticeship has been made a permanent activity of the U. S. Department of Labor. Paralleling this development, several states have enacted apprenticeship laws and other states have established state apprenticeship councils through appointment either by the governor or the commissioner of labor.

The federal committee set up committees on apprenticeship in each state which could issue wage exemptions to employers who wished to employ apprentices under standards adequate to safeguard the interests of the apprentices and the journeymen in the trades. The state committees on apprenticeship were composed of equal representation from labor and employers and representatives of state agencies interested in apprenticeship.

When the N. R. A. was declared unconstitutional all legal power of the federal and state committees on apprenticeship was removed. Since that time the federal committee and state agencies have proceeded with the development of apprenticeship on a voluntary basis.

Responsibilities of Federal Agencies

As the Federal Committee on Apprenticeship proceeded with its promotional efforts with employees and employers, it was apparent that the labor standards and educational functions of apprenticeship were not clearly defined.

Today, as a result of close cooperation, the relationship of the U. S. Department of Labor and the U. S. Office of Education regarding the development of apprenticeship has been carefully worked out in a joint statement prepared by the two agencies and submitted to the United States Congress. The statement pointed out:

"It is clearly and officially recognized by the President, the Office of Education, the United States Department of Labor and the American Federation of Labor, and by various national associations of employers and state governments, that there are two distinct groups of responsibilities and functions in the promotion and subsequent operation of plans for apprentice training. One group deals with the apprentice as an employed worker—the conditions under which he works, his hours of work, his rates of pay, the length of his learning period, and the ratio of apprentices to journeymen so that overcrowding or shortage of skilled workers in the trades may be avoided in large part. The second group of responsibilities deals with the apprentice as a student—the related, technical and supplemental instruction needed to make him a proficient worker and the supervision and co-ordination of this instruction with his job experience.

"It has been amply demonstrated that the responsibilities in connection with the apprentice as an employed worker can best be carried on by the State labor department which is charged with the general responsibility of improving working conditions and fostering the well-being of the workers, and that the responsibilities in connection with the apprentice as a student can best be performed by the State board for vocational education. These state agencies in turn look to the United States Department of Labor and to the Office of Education for leadership and research and for the determination of national standards in their respective fields . . ."

The group of responsibilities dealing with the apprentice as an employed worker are the basis on which the Federal Committee on Apprenticeship is carrying on its work. These responsibilities are generally called labor standards of apprenticeship. The Congress of the United States accepted this view and enacted the Fitzgerald Act (Public 308) which made the work of the Federal Committee on Apprenticeship a permanent function of the Department of Labor.

Duties of Committee

The Federal Committee on Apprenticeship acts as a policy recommending body. Members of the committee contribute their services without compensation. The work of the committee is carried on under the direction of the executive secretary, who has under him a limited staff of field men.

The functions of the committee are as follows: (a) To promote the adoption of labor standards necessary to safeguard the welfare of apprentices; (b) to extend the application of such standards by encouraging their inclusion in contracts of apprenticeship; (c) to bring together employers and employees for the formulation of standards of apprenticeship in their trade; (d) to cooperate with state agencies engaged in the formulation and the promotion of standards of apprenticeship; (e) to cooperate with the National Youth Administration, and with the office of education in services to apprentices; (f) to conduct research in various trades concerning the labor standards of apprenticeship and to publish information; (g) to act as a clearing house for information, so that national, state and local employers and labor organizations may benefit from the experience of similar groups in other sections of the country; and (h) to serve in a technical, consulting and advisory capacity to all agencies concerned with apprenticeship.

Minimum Labor Standards of Apprenticeship

The basic minimum labor standards of the Federal Committee on Apprenticeship are all contained in its definition of apprentice which is as follows: The term,

"apprentice," shall mean a person at least 16 years of age who is covered by a written agreement with an employer, or with an association of employers or employees acting as agent for an employer, and approved by the State Apprenticeship Council or other established authority, which apprentice agreement provides for not less than 4,000 hours of reasonably continuous employment for such person, and for his participation in an approved schedule of work experience through employment and for at least 144 hours per year of related supplemental instruction.

The national standards negotiated so far grew out of the successful apprenticeship systems developed through the cooperation of local employer associations and labor unions. For example in Chicago, St. Louis and in many other cities throughout the country apprenticeship has been established for over 15 years. These local apprenticeship systems have served as experimental laboratories wherein workable procedures have been developed. The national standards are a national copy of the successful local apprenticeship systems which have existed for years.

Apprenticeship for Railroad Boilermakers

With the foregoing discussion serving only as a background of information, I assume that one of the first questions you might ask is this: Is it worthwhile, is it possible, and is it necessary eventually to formulate and place in operation National Standards or a National System of Boiler Making Apprenticeship for the Railroads? That question can be answered in this manner. My observation of the railroad boiler-making trade, meager though it is, leads me to say that boilermaking is one of the oldest and most exacting of the skilled trades. Railroad boilermakers, skilled in all of the processes and divisions of their trade, are always needed. Regardless of the fact that some of the operations of the boilermaking trade are mechanized, there will always be a need for skilled craftsmen.

For many years, the railroads have developed all of their mechanics, including boilermakers, through apprenticeship. Therefore a vast amount of information exists regarding the conduct of apprenticeship in all of the railroad shop crafts, including boilermaking. Because of this background of facts regarding boilermaking apprenticeship, your association is in a position to contribute much toward the further development of apprenticeship.

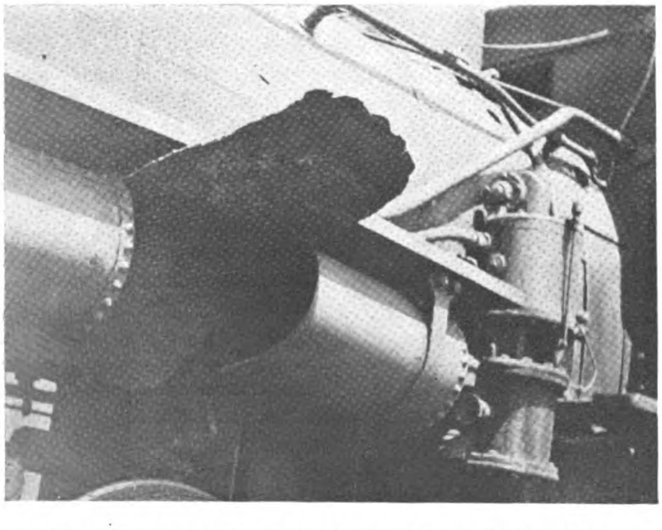
Since employers, labor, the federal government, and many of the states are cooperating effectively in placing apprenticeship on a more stable basis, it would appear that your association should examine the possibility of strengthening apprenticeship in your field of activity. What is needed, I believe, is a comprehensive study by your association of the problem of apprenticeship as it affects your members. I hope you find it advisable to conduct this study and report recommendations to your next convention. With the facts at hand, you can determine the extent to which apprenticeship should be emphasized as an activity of your association. The Federal Committee on Apprenticeship will be pleased to assist you in your efforts in any way you wish.

Inspection, Testing, and Cleaning of Air Reservoirs

Committee recommends standard methods and is of the opinion the hammer test should be made every two years instead of every 18 months

The committee sent a questionnaire to the leading boiler men in this country and Canada. It has considered the varied practices and has based the report on the answers received with respect to the desired standard practice.

In a general discussion of the results of the survey, the committee recommended the use of a special extension light instead of a flashlight in the inspection of the reservoirs because it permits the actual condition of their interiors to be determined more accurately. It also stressed the importance of the proper size, type, and use of the hammer in the hammer test. The survey showed that the majority of the railroads removed the reservoirs for the hydrostatic and hammer tests. The committee reported that the majority of railroads specify copper-bearing metal for new reservoirs with longitudinal riveted seams and welded or spun semi-convex heads. A few railroads had reservoirs cast integral with the frame which, to date, had given satisfactory service.



Defective air reservoir which failed at hydrostatic test due to deterioration of the sheets

The committee made the following recommendations for the inspection, testing, and cleaning of air reservoirs:

Inspection: A daily inspection to see that the reservoirs are in good condition. An internal inspection to be made at hydrostatic and hammer test period using a special inspection light. If local conditions warrant, an internal inspection to be made at shorter intervals. A thorough inspection of the interior of the reservoir to be made at specified periods of the drum head, riveted seams, and for pitting and grooving.

Testing: Daily test by air inspector to see that reservoirs are in good condition. All reservoirs to be removed from locomotive for hydrostatic and hammer tests.

Use 1½-lb. ball pein hammer with medium blow for hammer testing. When applying hydrostatic test, drain cock to be opened to be sure that all air is released from reservoir before reaching the specified pressure. Hydrostatic test to be applied after 12 months service, provided

such service is performed within two consecutive years.

Hammer test to be applied every two years so date will coincide with hydrostatic test, caps, flues, and lagging. It is the desire of the committee to comment particularly on this recommendation. It is the consensus of opinion, considering the average life of reservoirs, being 15 to 20 years and that they are given an annual hydrostatic test, that it would not create a hazard to extend this text six months. The advantage would be to make the hammer test coincide with dates covering caps, flues and lagging. Reservoirs to be hammer tested before applying hydrostatic test, inasmuch as the hammer test may develop defects that would not appear under hydrostatic test.

Cleaning: Drain cocks to be opened daily or after each day's work, allowing all condensation and foreign matter to be drained or blown out. Reservoirs to be removed from locomotive at hydrostatic and hammer test periods to permit proper cleaning of interior. At enginehouses where cleaning vats are not available, reservoirs should be placed over pit, at an angle of 45 deg. and washed out with hot water using standard boiler washout nozzles. At backshops and larger enginehouses, reservoirs should be placed in cleaning vats with suitable solution for cleaning inside and outside of reservoirs.

This report was read by Chairman L. R. Haase, district boiler inspector, B. & O.

Discussion

A. F. Stiglemeier, general boiler department foreman, New York Central, said their practice was to remove the head to make an interior inspection, after which the head is reapplied by riveting. He cited their experience of finding pitting and scale on the inside of the reservoir which was not indicated by a hammer test.

C. W. Buffington, general master boilermaker, Chesapeake and Ohio, however, made the statement that a good inspector can determine the condition of the reservoir by a hammer test without the added expense of removing the head.

F. Yochem, general boiler inspector, Missouri Pacific, spoke of the excessive hammering of reservoirs which made large dents and weakened them. He was of the opinion that better judgment could be used in making the hammer test.

M. V. Milton, chief boiler inspector, Canadian National, remarked that as the same conditions do not exist on all railroads, individual policy should determine whether it is necessary to remove the head in making an inspection of air reservoirs.

Welding and Alloy Steel in Tender Cistern Construction

Reports indicate all-welded construction is satisfactory and that further experience is necessary to determine the value of alloy steel

The committee endeavored to secure all possible information from members of the association who have tenders of welded construction on the railroads which they represent. It does not feel justified in asking the association to adopt any type of construction or any grade of steel for tenders because the experience with welded construction is insufficient at this time to make definite recommendations. The committee presented reports from several members in order that the members of the association could be helped in forming their own conclusions.

Report by A. W. Novak

We have in service 82 all-welded cisterns which are of the rectangular type with cast-steel water bottoms. These cisterns were built by the locomotive builders with the exception of 18 which we constructed in our own shops in 1929, 1930, 1931.

The cisterns, with the exception of six placed in service in 1938, were constructed of 5/16-in. common tank steel. In the last six cisterns received 1/4-in. Cor-Ten steel was used for roof sheets, coal-pit sheets, and all wash plates. Due to the inability to avoid distortion of the Cor-Ten plates, 5/16-in. common tank steel was used for the sides and back wall which gave a better appearance.

Two months after 15 cisterns built in 1929 and 1930 were placed in service, cracks developed in a large number of the wash plates in each cistern. These cracks took place adjacent to the intermittent welds made at the ends of the plates and also in the exact center of the plates far removed from any weld.

The cracking which developed in these plates was directly due to the fact that no provision had been made to prevent the flexing or movement of the wash plates by the surging of the water. In view of this excessive cracking it was necessary that we make immediate repair. This was done by applying 3/8-in. by 3-in. by 3-in. T-iron stiffening to all of the wash plates, two such T-irons were applied the full length of each transverse and longitudinal plate, the T-irons being located one-third the distance from top and bottom of each plate. In an effort to learn whether the application of these T-irons would arrest the movement of the plate the cracks which existed were not welded, center marks were placed at each end of the cracks so as to learn if their progression had been stopped. These cracks were observed for a period of two years and in no instance was it noted that they had extended. As these engines were then coming into the shops for machinery repair, arrangement was made to have all cracks welded up. Since the T-iron stiffening was applied to the wash plates these engines have accumulated over 1,100,000 miles and no further repairs have been necessary.

The cisterns placed in service in 1931 were similar in design to those received in 1929 and 1930 with the exception that the wash boards had T-iron stiffening applied to them. The engines with these cisterns have accumulated over 1,000,000 miles since being received and there has been no cracking noted and no repairs have been necessary.

The 18 cisterns which were built in our own shops and placed in service in 1929, 1930 and 1931, were of the same design but of greater capacity than those previously referred to and T-iron stiffening was applied to all wash plates. The coal pit space in these cisterns was converted into an oil cistern. This arrangement presented an oil and water cistern being welded integral. The only cracking in these cisterns has been in the front sheet of the oil cistern which was caused by the vibration of an open-type oil heater set in the oil cistern. Additional stiffening was applied to this sheet and there has been no further trouble.

The cisterns placed in service in 1937 and 1938 have

given no trouble by cracking in the wash plates to date. The design of these cisterns was the same as the lot built by us and had stiffening applied to all of the wash plates. We have experienced some cracking in the plates forming the hot-well compartment for the feedwater heater and we have had to apply reinforcing to stop the cracking.

The cisterns placed in service in 1935, 1936 and 1938, were of practically the same design and had a wash-plate arrangement similar to our other welded cisterns. No bracing or stiffening was applied to any of the wash plates to reduce the total weight of cistern and in a further effort to reduce weight on the last six cisterns built in 1938, ¼-in Cor-Ten steel plates were used for all plates excepting the sides and back wall. A shielded arc of heavy coated electrode was used for all welds and the type of welds was the same as employed for all our welded cisterns. After two months of passenger service many of the wash plates in these cisterns were found to be cracked. The wash plates of Cor-Ten steel had cracked to a greater degree and cracks were of more irregular type indicating brittleness of the steel and greater damage caused by welding. It is necessary that we increase the weight of these cisterns by applying the necessary stiffening to all wash plates if cracking of these plates is to be stopped.

It is our opinion gained from our own experience that the all-welded cistern has considerable merit and is superior to the cistern of riveted construction providing consideration is given to properly stiffening the wash plates to prevent their movement or flexing by the surging of water. If this is done it is felt that the maintenance cost of the all-welded cistern will be negligible. The use of alloy steel for the sides and back wall of cisterns does not appear desirable unless some type of steel or method of welding can be found that will prevent the unsightly distortion. Light alloy steel plates can very possibly be used for the roof sheets, coal-space sheets and all wash plates and wherever sheet distortion is not objectionable. However, the thinner the wash plates are the more stiffening or bracing will be required to prevent their cracking. It is our opinion that thin plates of common tank-steel quality can be used equally as well as alloy-steel plates providing they receive a like arrangement of stiffening and should give better results as they are less affected by the welding process.

Pitting and corrosion has been eliminated in the interior of our cisterns that were built in 1929 and 1930 by the application of a rust preventative. The coal-space sheets and roof sheets which were coated several times have rusted some and become thinned, this however is due more to cinder cutting and coal wear than rusting. This type of wear will also take place with alloy steel plates. As we have only six engines where alloy steel has been used for the roof sheets, coal-space sheets, and wash plates, and as these have been in service less than a year we are unable to give any exact opinion as regards to pitting and corrosion of these sheets. We have mentioned that where the rust preventative applied on these sheets had come off some evidence of rusting is noted, but how extensive this will become we are unable to say at this time. We know of no alloy steel used in the construction of locomotive cisterns thus far that will absolutely resist pitting or corrosion; if such steel can be found it would not doubt prove very valuable.

Report by B. C. King

Twelve locomotives built in 1930 have all-welded tanks with straight sides. T-irons applied horizontally on sides are welded to side sheet with continuous weld. These are the T-irons to which splash sheets are fastened. The tank sides are cracking at this weld. Ten locomotives built in 1934 having the flat-top semi-Vanderbilt tank have not given any trouble up to this time. Eleven locomotives built in 1938 of which three are oil burners, semi-Vanderbilt type have given no trouble so far, but all the oil tanks which are placed in the coal space have straight sides with T-irons applied horizontally on sides with continuous weld. The sides of these oil tanks cracked at the T-iron weld within six months after being received from builders. From this it appears that T-irons should be riveted in place of welding. We have had no pitting or corrosion in the tanks which have copper-bearing metals.

Report by V. B. Vogel

By the use of all welded construction, the weight of our present cisterns could be reduced materially by the elimination of angle and T-irons. This alone, on large tanks ranging from 20,000 to 23,000 gallons, would be a reduction of weights amounting to 18,000 to 20,000 lb. This, and elimination of 1,500 lb. of rivets, as well as the use of a lighter gage metal of alloy steel with higher tensile strength would make it possible to reduce weight as much as 18 or 20 per cent.

The possibility of leaks developing after being put into actual service, would be reduced to a minimum and reduce cost of maintenance. The use of alloy steel, such as Cor-Ten, to resist corrosion and chemical action of water, would assure uninterrupted service of cisterns of welded construction. Welded construction makes it possible to build tanks of such design and shape to conform to the present trend to streamline.

The disadvantages, in my opinion, are largely imaginary and are the set ideas of men without a thorough knowledge of welded construction.

Report by J. P. Powers

The Chicago & North Western purchased nine 4-6-4 locomotives early in 1938. These locomotives have the all-welded cisterns except for the swash plates, which are riveted. All plates used are carbon steel. These cisterns have given satisfactory service with practically no maintenance cost to date. The increased cost of alloy steel must be taken into consideration, and unless it is required to keep within certain weight limits and maintain water and fuel capacity, carbon steel can be successfully used by careful design.

Our experience with pitting and corrosion of locomotive cisterns shows that it is mostly due to ordinary rusting, particularly when the cistern is empty and stored for some length of time. On coal-fired locomotives, corrosion on the outside is due mostly to sulphuric acid from coal, cinders and moisture. Changes in operating conditions on many of the railroads now require locomotives to operate on long runs, and many locomotives are designed for this purpose with tenders large enough to eliminate stopping for coal and water. When designing locomotives for such purposes advantage can be taken by using alloy steel and welding in order to reduce weight.

Report by S. A. Schickedanz

The use of welded structure eliminates, to a large extent, the fabrication of the material to be welded. It can be seen that elimination of angle connections, bolts and rivets will produce a reduction of weight of the finished product and the welded structure will be of equal or greater strength than the riveted or bolted structure.

Reduction of weight is also obtained by the use of high-tensile steel. However, it appears that several factors must be considered in doing this. Moving versus

static loads must be given consideration, also the fact that a liquid load in a cistern will produce entirely different stresses and conditions than the more solid loads. Theoretically, the advantages obtained by the use of alloy steel in the construction of tender tanks are: (a) The reduction of weight, (b) greater strength and, (c) greater corrosion resistance. As to greater corrosion resistance, the use of this grade of material has not been extended over a sufficient period to say definitely that an improvement has been effected. Since the yield point for alloy steel occurs at a higher unit stress than for carbon steel, it is evident that with the same factor of safety, a higher designing unit stress may be used, although care must be taken not to reduce the thickness of the plate to a point where it will be subject to undue deflection, which will result in ultimate cracks. The alternate is to provide additional stiffness, which offsets the saving in weight due to use of thinner plate and makes for more costly construction. Therefore in structures of this type the fatigue and endurance limit values are of great importance. The working unit stress should be based on the endurance limit when it is less than the yield strength of the steel.

Following are some experiences of two railroads with this type of construction which seem to substantiate or agree with above reasoning: One railroad advised the construction of 20 all-welded tender cisterns having a capacity of 26 tons of coal and 23,000 gallons of water, in which the principal sheets were 5/16-in. and 1/4-in. Cor-Ten steel with a saving of 7,147 lb. per tender compared with the tender of ordinary steel and riveted construction. This road built a similar tender except with principal sheets 1/4-in. and 3/16-in. Cor-Ten steel and all-welded construction. The saving in weight of this tender was 12,053 lb. The above tenders were built in 1936 and 1937 and so far there has been no difference in the maintenance nor in the character of service of the cistern with the thinner sheet than in the case of the tender with the heavier sheets.

Another railroad had some tenders of 20,000 gallons capacity and 25 tons of coal that weighed, ready for service 397,000 lb. and light weight of 180,400 lb. These tenders were equipped with cast-steel water bottoms and had tank quality steel cisterns. They built additional tenders same as above except with a reduction in weight in water bottom casting of 3,200 lb. The outer plates were of tank quality steel, and lighter gage alloy steel was used for splash plates and braces, accounting for a further reduction of 18,800 lb., or a total reduction in weight of tender of 22,000 lb., thereby reducing the ready-for-service weight from 397,000 lb. to 375,000 lb. In this case in less than one year in the lighter weight tenders, cracks are developing alongside of welds where flat plates are joined to angle or the iron braces. They are of the opinion that there is not sufficient stiffness in these plates to resist buckling and after applying sufficient strong backs or braces, the saving in weight will be greatly reduced. Of the two groups of tenders mentioned, the heavier one using tank steel throughout has given little or no trouble, while the lighter tender using lighter gage steels for interior parts of cisterns will require considerable reinforcing to prevent cracking of sheets. It was also noted that the cracks developed on the alloy steel sheets, none having occurred on the tank steel outer sheets.

A well-known locomotive designer expressed his opinion as not being in favor of what is ordinarily termed an all-welded construction. In all cases where the vertical T-iron was welded to the side of the tank and not riveted, the side sheet cracked just outside of the edge of the T-iron where the welding was done, no doubt, due to the unavoidable deflection of the sheet between the T-irons.

A number of cases have developed where all-welded construction has failed. In general it would seem that it is not advisable to raise the stress in alloy steel in proportion to the increase in yield point. As deflection is a function of the modulus of elasticity, and the modulus of elasticity of alloy steel is not far different from that of ordinary steel, it would seem that the proper procedure would be to take advantage of about one-half of the increase in yield point rather than attempting to go the whole way. For instance, if an ordinary tank with side sheets of 1/4-in. ordinary plate is satisfactory and an alloy steel with double the yield point were to be used, it would not seem sensible to assume that we could make the side sheet out of 1/8 plate; probably 3/16-in. would be satisfactory.

As to corrosion, information gathered from various sources seemed to indicate that copper-bearing open-hearth steel is practically as resistant to corrosion as alloy steel in this service. More study and tests seem necessary before it can be definitely stated that light-weight high-tensile steel will be more resistant to corrosion than copper-bearing open-hearth steel when used in locomotive cisterns.

Training Boilermaker Apprentices to Become Better Mechanics

Committee report outlines program for developing boilermaker apprentices having a more thorough knowledge of boiler work

Those entering the field of boilermaking should be reliable characters of high ability, and the selection of the apprentice should be given first consideration. A prospective apprentice should be able to speak, read and write the English language with an appreciation for correctness. He should pass physical examination by a company doctor. He should be able to understand and apply the four methods of calculation of addition, subtraction, multiplication and division, in both fractions and decimals and pass an examination on these various phases of arithmetic before being permitted to enter on an apprenticeship.

Railroads in the past have had three classes of apprentices, regular, helper and special. An applicant for regular apprenticeship should be between 16 and 21 years of age and pass the regular entrance examination. If accepted, he should serve four years of 290 eight-hour days for each calendar year. An applicant for a helper apprenticeship should be a regular boilermaker helper with at least two years experience and between 21 and 30 years of age. In selecting helper apprentice, ability and seniority should govern. He should be required to pass the same entrance examination as the regular apprentice. Helper apprentices should serve three years of 290 days of 8 hours for each calendar year. A special apprentice should be selected from young men between 18 and 26

years of age who have had a technical education and they should serve three years of 290 days of 8 hours for each calendar year.

Each boy selected should be put on probation for the first six months of his apprenticeship. During this period the supervisor should study the boy as to his habits and general fitness for the trade he has chosen. An apprentice board consisting of the master mechanic, general foreman, erecting foreman, and apprentice instructor, should be set up. This board should meet at least once each month and discuss the progress the boy has made. If at the end of the probationary period the apprentice has shown no aptitude for learning the trade, he should not be retained.

There are two problems in the education of an apprentice; the learning of the trade proper, and the development of the apprentice's ability to use technical knowledge, so he may be a better asset to himself and to the railroad.

Shop Training

The following is suggested as a tentative schedule of time to be spent by the apprentice in the various departments:

Toolroom: 1 month—General instructions on names and purposes for which tools are used and the grinding and sharpening of tools.

Heating Rivets: 2 months—Proper preparation and maintenance of fire bed of coal or coke, and the proper degree of heat for rivets in various types of work.

Front End Work: 1 month—Netting and self-cleaning front ends, preparation of details and assembling of dampers and deflector plates.

Ash Pan: 2 months—Constructing and fitting up pans, slides, doors, and operating rigging.

Tank Shop: 2 months—General construction of tanks, importance of watertight joints and security of braces and gussets, miscellaneous tank work, air reservoirs, track tanks, etc.

Staybolts: 3 months—Importance of good threads in reaming and tapping holes, measuring and applying staybolts.

Riveting, Chipping, Calking: 3 months—Reaming holes for riveting, properly ground chisels, proper angle of beveling, properly formed calking tool to insure not scoring or damaging the plate under the edge or splitting the sheet. Hammers, dolly bars, etc.

Hand and Machine Flanging: 3 months—Miscellaneous flanging, both hot and cold work.

Enginehouse: 3 months—General hot work, light repairs, inspection of boiler under steam for leaks, bulges, etc.

Welding, Forge and Fusion: 3 months—All types of welding and instructions as to which parts are permissible to weld and which are not.

General Work: 8 months—This to include boiler shop special work not specifically mentioned such as special emergency jobs which might come in, power plant or stationary boiler work, or equipment for cranes, pile drivers, etc.

Inspecting: 3 months—All apprentices should know the I. C. C. Boiler Inspection Rules and they should be given thorough instructions on methods of making interior inspection of sheets, braces, rivets, staybolts, etc., so that defects will be readily recognized; also exterior inspection, and inspection under hydraulic and steam pressure.

Laying Out: 4 months—Laying out all types of boiler sheets, both by development and by templets.

Machine Work: 2 months—General instructions on the operation of all boiler shop machines.

Cabs: 1 month—Getting out details and constructing cabs.

Patching and Fitting Up: 4 months—Boiler reinforcements meeting I. C. C. rules. All kinds of fitting-up work.

Special apprentices are trained in all branches of shop work. At the completion of their apprenticeship they are given opportunity to select the craft in which they desire employment. The first two years are spent in all branches of the shop. The last one or two years are spent in the craft in which the apprentice desires employment. As a general rule, the special apprentice chooses the machinist craft. It is reported one Southern road this year will employ eight special apprentices who, according to contract, will follow boiler maintenance the last two years of their apprenticeships.

Technical Training

In regard to the second problem—the technical training should consist of studies in mathematics, mechanical drawing, mechanics, and some knowledge of geometry. The regular and helper apprentice should be required to attend the apprentice school two-hour periods two days each week. School is generally held after shop working hours with good results under the direct supervision of a competent apprentice school instructor.

Mechanical drawing should be taught each apprentice and he should, from such instruction, be able to lay out and build from blueprints a complete locomotive boiler of small size from scale. He should also be able to figure the safe working pressure of the various types of boilers, air reservoirs, and other pressure vessels.

In the last twenty-five years the art of acetylene and electric welding has been created and great progress has been made in many branches of these arts until today it is almost a requirement that a boilermaker and the boilermaker apprentice do welding with both these methods. No apprentice should be allowed to finish his trade and become a boilermaker without being qualified as a competent electric and acetylene welder. Where there are machines for testing the various kinds of welding, the apprentice should be able to weld test pieces and have them tested to determine his proficiency as a welder.

Other Recommendations

The boys should be given a copy of the book of rules on safety, or if not available, they should be told and made to realize the importance of observing carefully at all times, the common rules of safety, and every precaution should be taken to impress on them the serious consequences which might result from carelessness in this respect. If it were possible we should have a monthly magazine devoted entirely to boilermaking in all of its many branches, such as we have had in years gone by when we had the monthly magazine called "Motive Power," which later became "The Boiler Maker." Many of the present-day layer-outs, boiler inspectors, and boiler foremen owe their present positions to the many things that they learned in these magazines.

The master boiler foreman can aid the apprentice instructor greatly by taking an active interest in the apprentices' advancement. Not only this, but our superintendent of motive power, when he visits such centers as have apprentice instructors, should endeavor as far as possible to call the apprentices together and give a talk that will encourage the apprentices to greater effort and make them feel that they are part of the railroad.

After four years training and instruction, the boys who are the most proficient and have shown the most aptitude and ability will be readily recognized and there will be no trouble making selection of the most competent

man to become a supervisor when there is a vacancy.

The report was read by Chairman A. T. Hunter, assistant general boiler inspector, Atchison, Topeka, and Santa Fe.

Discussion

D. J. Sheehan, superintendent of motive power, Chicago and Eastern Illinois, said that he does expect all of his apprentices to be placed on jobs after they complete their training, but he feels that although the release of apprentice graduates will be his loss, the railroad industry somewhere is going to gain a good mechanic. He spoke of the necessity of not retaining boys who show little aptitude, and of the reluctance of supervisors to report boys who make unsatisfactory progress in their departments.

A. G. Turnbull, chief mechanical engineer, advisory mechanical committee, Chesapeake & Ohio, discussed the need of scheduled courses for apprentices. He said a well-rounded course should be given apprentices instead of training them in one direction. He urged the practice of keeping apprentices on work for which they had shown particular aptitude be discontinued.

D. J. Ellis, chief mechanical officer, Chesapeake & Ohio, said that the craft needs the youths more than they need the craft and, therefore, the railroads should consider seriously what it has to offer that will attract them to the boilermaking craft.

Means for Improving the Circulation of Water in the Boiler

Boiler check location, feedwater temperature, firing practice, and devices in firebox are factors affecting the flow of water

Unless there is approximated a uniform temperature throughout the boiler, stresses and strains of a violent nature at many different points are set up, the results of which we see every day in leaking and broken staybolts, warped and cracked firebox sheets and deterioration of the water surfaces of the boiler in general.

In the study of this topic your committee has deemed it advisable to divide the question into several separate divisions for the purpose of consolidating and closely grouping opinions and avoiding duplications of ideas.

Conditions Adversely Affecting Circulation

Almost without exception it seems to be the universal opinion that the primary factors causing poor locomotive boiler circulation do not involve so much the fundamental design of the present boiler, but rather results from: (a) the entrance and impingement of feedwater at low temperatures, (b) improper water conditions and, (c) poor firing practices.

More concentrated effort should be applied towards correcting low-temperature methods of feeding water to the boiler. It is commonly agreed that the only ideal condition in this respect would be for the feedwater to enter the boiler at approximately the working boiler-water temperature. Until such time as something similar to this can be accomplished, the use of exhaust-steam injectors, feedwater heaters, automatic live-steam valves, heat boosters, spray and mixing nozzles, etc., to increase the temperature of the injected feedwater before it comes in contact with the various internal parts of the boiler, and the syphon, circulator and arch tubes to forcibly drive the hotter water to the more remote parts of the boiler, is earnestly recommended to your consideration in trying to bring about the ideal of a continuous and steady flow of boiler water from the firebox to the front tube sheet and back again.

Chief among the secondary factors adversely affecting circulation is the accumulation of scale and sludge, resulting from water of poor boiler quality, which forms in the boiler and is deposited particularly at the forward end between the flues and tubes, thus preventing the incoming water from freely finding its proper circulatory path to the bottom of the shell and back to the firebox surfaces. Another secondary factor affecting circulation is the location on the boiler at which feed water is injected. Our survey would further indicate that circulation is greatly affected through poor valve setting, valve and piston blows, improper size exhaust nozzle and smoke stack, improperly drafted locomotives, and poor firing practices.

Corrections to Present Boilers

With regard to the proper location of boiler checks, our survey indicates that all are in agreement that this is near the front end of the boiler, but there are some differences of opinion as to whether the correct point is at the top or side. From data received, it would seem that with the use of the top check, results have been most satisfactory. It is recommended that the water enter the boiler over a baffle plate or through a recently developed spray nozzle which spreads the water entering the boiler, thus helping to prevent the sludge and scale accumulations at this location and providing for a better condition in connection with the final contact between the two bodies of water of different temperatures. Two members of the committee report that in their experience when a change was made to a top delivery of water to the boiler, staybolt and side-sheet troubles were very materially reduced.

As to sludge and scale accumulations affecting free circulation, all agree that this condition is being successfully minimized through the use of boiler feedwater treatment, proper adherence to blowing schedules to keep the dissolved solids below the foaming level, and the regular washing out of the boiler. In connection with the accumulation of sludge at the front end between the flues, tubes and sheets, it has been suggested by two members that a blow-down arrangement be applied to the bottom of the first course adjacent to the front tube sheet to provide a means of cleaning such accumulations which have a tendency to slow circulation in this location.

A study of firing practices should be made, particularly at lay-over points and terminals, because at the time of the fire-up many of the destructive forces of expansion are brought into action. It has also been suggested that a further improvement can be made on grates used in locomotives equipped with a brick arch, that after the necessary per cent of grate opening has been determined, the grates be applied with that opening graduated from front to rear, arranging for from 30 to 50 per cent greater opening at the front than at the rear of the firebox so that the lesser openings would be at locations of the greatest draft, the distribution of the openings to be determined through proper tests.

It is generally believed that the use of firebox syphons and circulators as well as arch tubes do much towards increasing circulation in the boiler, as these devices, as previously stated, have a tendency to force the current of heated water to the forward end of the boiler where the great portion of our problems exist.

Corrections in the Design of New Boilers

Last year we heard W. R. Hedeman of the B. & O., report on the wonderful results they had been obtaining from the use of their water-tube fireboxes. We have information from him that at present they have 12 such locomotives in service, which have accumulated an additional 678,000 miles since his last report, the total now being 4,678,000 miles of service since built, which naturally speaks for itself. He assures us that the service obtained from these locomotives has been very satisfactory, that with the rapid circulation with this type of firebox, interior barrel conditions have been materially improved. We believe this idea may be a partial solution to at least some of our problems, and in the design of any new locomotives it should be given careful consideration.

We have received a recommendation that the foundation ring be constructed considerably wider than at present in order to adequately accommodate blow-down systems that are generally applied with blow-down arrangement to the bottom of the first course. It is further stated that if the foundation rings were increased in width from the conventional 5.5 in. to a 7.5 in. width this would increase the water supply 36 per cent at the point mentioned and this should also be very beneficial in high temperature fireboxes. It has been recommended that superheater flues 3½ in. in diameter are not large enough to be practical on coal-burning locomotives, and it has also been suggested that superheater unit bands be so applied as to offer less resistance to the cinders and clinkers passing through the flues.

The committee believes that staybolt leakage is influenced very greatly by all the factors connected with circulation, which have been previously discussed. However, the committee also recommends that in the application of staybolts the best workmanship possible should be used. In that connection one of our members has made the claim that the practice of using a small button on the staybolt hammer, which drives the bolts first in the center, upsetting them through the sheet, and in a second operation using the ordinary flat button to lay up the edges of the bolts, has been very successful in improving staybolt conditions.

The report was read by Chairman C. A. Harper, general boiler inspector, Cleveland, Cincinnati, Chicago and St. Louis.

Locating Height of Crown Sheet and Water-Level Indicating Devices

Committee recommends two methods, one for use with new boilers, other for locomotives receiving classified repairs

The application and maintenance of water columns, water gage glasses and gage cocks as referred to in this paper must meet all the requirements of the Interstate Commerce Commission, Bureau of Locomotive Inspection. Under these requirements the lowest gage cock and the lowest reading of water glasses must be not less than 3 in. above the highest point of the crown sheet.

From the information gathered by your committee we feel that either of the two methods described will prove satisfactory for locating the height of the crown sheet, water glasses and gage cocks, and we feel that when new boilers are built or existing boilers are given new fireboxes that method designated as No. 1 should be used, this method being the most accurate. For checking the height of crown sheet, water glasses, and gage cocks in the enginehouse or shop on classified repairs the method designated as No. 2 should be used.

After the boiler has been permanently attached to the frames and cylinders the frames should be leveled longitudinally and transversely. When leveling angles have been applied to the first and second barrel courses at the center line as shown in Fig. 1, notches are to be sawed in both brackets with the face *D* exactly level.

Method No. 1

A test cock or stud hole is located in the top of the shell directly over the highest point of the crown sheet. The test cock or stud is removed as is any convenient stud in the back head that is well below the water line. A pipe nipple, threaded the same as the boiler stud and to which is attached a rubber hose having a tubular water glass in the free end and of sufficient length to reach the right and left sides of the boiler head, is inserted into the stud hole in the back head.

The boiler is then filled with water to well above the anticipated water line. A metal rod ¼ in. in diameter

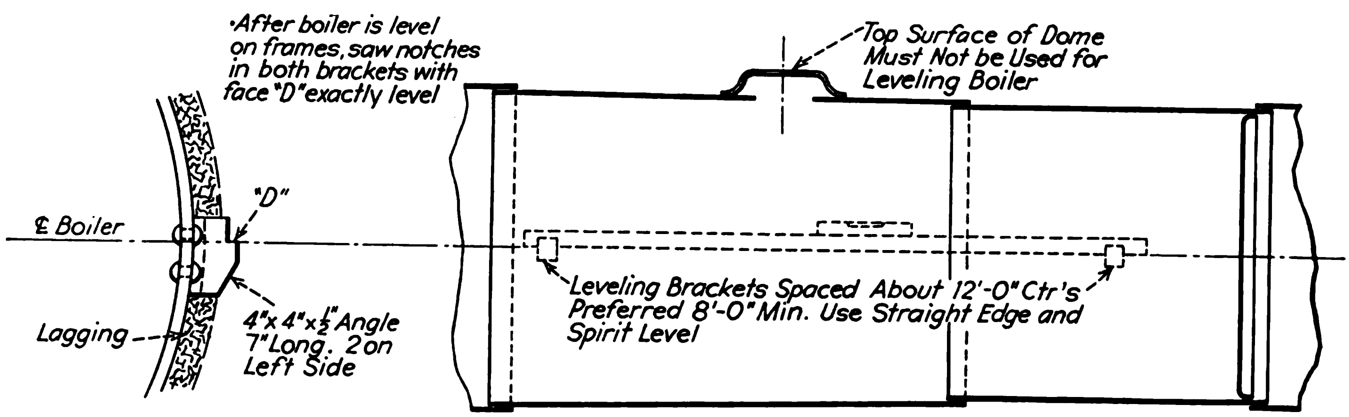


Fig. 1—Permanent markings for leveling boiler

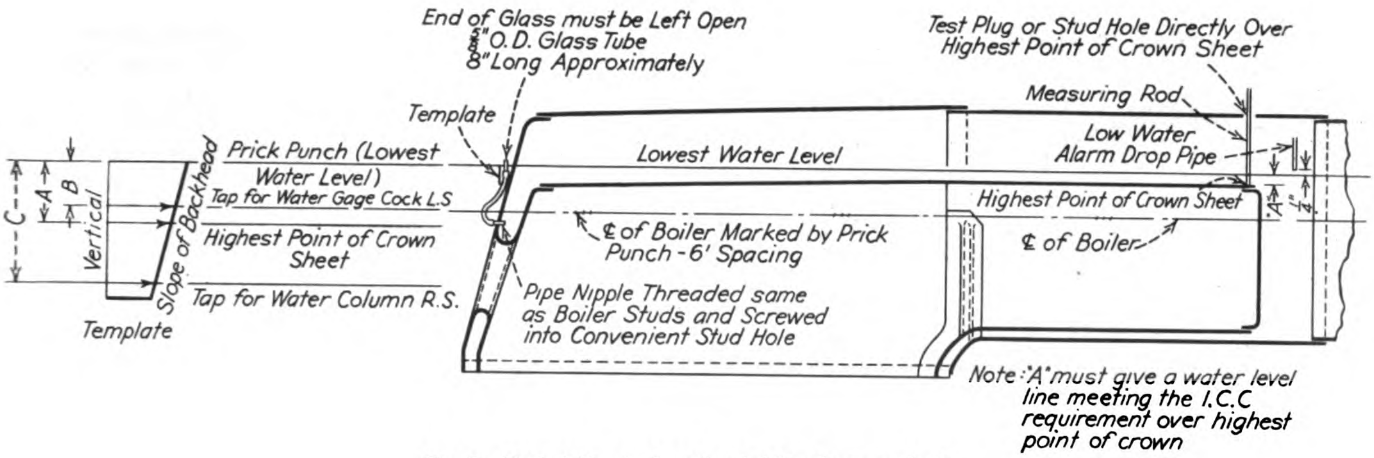


Fig. 2—Method No. 1—Locating height of crown sheet

is chalked and inserted into the test hole in the top of the shell and abutting on the crown sheet. The rod is withdrawn and the depth of the water noted. The water level is then lowered by opening a blow-off cock until the desired water level required to be carried above the highest point of the crown sheet is reached. Care must be exercised in inserting the measuring rod that it rests on the crown sheet and not on the flue sheet flange or rivet head. The free end of the hose with the water glass inserted in the end is held against the back head. Prick-punch marks corresponding to the water level in the glass are made on the right and left side of the back head so that a straight edge and spirit level can be used to check the transverse level and a line scribed across the back head to represent the lowest reading of the water-level indicating devices. Prick-punch marks and a line to mark the highest point of the crown sheet should then be made on the back head below the line of lowest water level; the distance of this line from the lowest water level line is to be the same as the height of water over the highest point of the crown sheet as shown by the chalked measuring rod. The location of the water-level indicating devices should then be laid out from the line marking the highest point of the crown sheet using a template similar to that shown in Fig. 2 and in accordance with the standard practice of the railroad.

Method No. 2

A rubber hose should be provided which is long enough to reach from the front end of the firebox at the highest point to or above a corresponding height on the back head and having a tubular water glass inserted in each end of the hose with the exposed ends of the glasses ground irregular to permit the escape of air when the glass is held against the crown sheet. The hose should be blown through to assure its being free of obstructions and filled with water. Care should be taken that it is free from air pockets and that no kinks are formed in the hose. One end of the hose is taken into the firebox through the fire hole and the other end is held against the back head at the approximate height of the crown sheet. The glass in the firebox end of the hose is placed against the crown sheet at its highest point and the height of the other end of the hose is adjusted with the glass against the back head until the water is on a level with the top of the glass held against the front end of the crown sheet. The water level in the glass held against the back head is then marked on the back head in a sufficient number of places so that a straight edge and spirit level can be used to check the transverse level. A line is scribed across the back head the thickness of the crown sheet above the mark corresponding to the height of water in the glass held against the back head. This line represents the highest point of the crown sheet and is the base line from which measurements are made for application of the water-level indicating devices in accordance with the standard practice of the railroad.

Locating Low-Water-Alarm Drop Pipe

After the pipe is installed the boiler should be leveled in the same manner as for locating the crown sheet height.

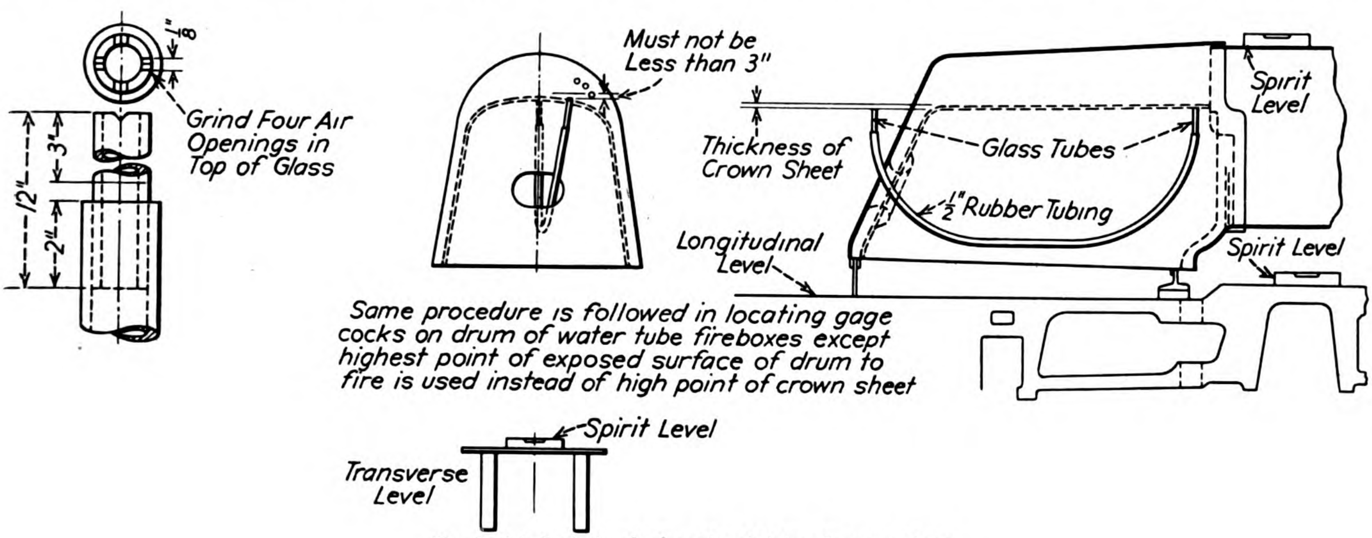
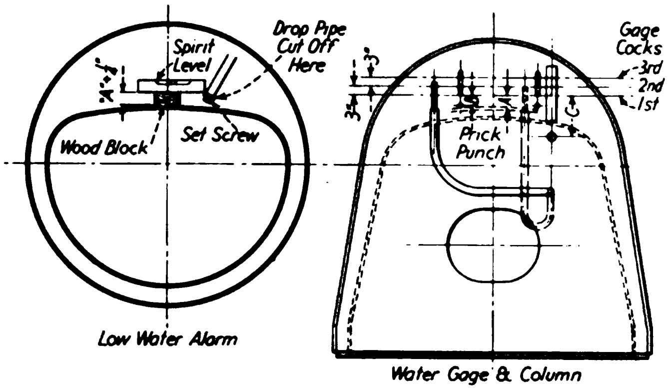


Fig. 3—Method No. 2—Locating height of crown sheet



Water gages, gage cocks located and low water alarm drop cut off after boiler is mounted on frames with frames leveled and before engine is wheeled.

Fig. 4—Locating height of low-water-alarm drop pipe

A wooden block 24 in. in length, having a parallel top surface and with the bottom surface cut to conform to the radius of the crown sheet, is placed transversely across the crown sheet at the highest point. This block should be so made that the approximate center of its length will contact the highest point of the crown sheet and the thickness of the block at the point of contact to the highest point of the crown sheet should equal the desired height of the drop pipe opening above the highest point of the crown sheet. The top of the block is then leveled crosswise of the boiler and the height is transferred to the drop pipe by means of a straight edge and spirit level. The pipe is then marked at the proper height and a ring gage is slipped over the pipe and secured by a set screw, the top surface of the ring gage being used as a guide for the saw in cutting off the pipe. Low-water-alarm drop pipes are usually on an angle of 25 deg. from the vertical and the cut should be made square with the pipe.

Badge Plate and Crown-Sheet Marker

A metal badge plate showing the safe working steam pressure and having a line showing the highest point of the crown sheet should be securely attached to the boiler head. If the boiler head is lagged the jacket and lagging should be cut away so that the plate can be seen. The badge plate should be located as near the vertical center line as possible and should be so applied that the crown sheet line coincides with the height of the highest point of the crown sheet.

A metal bench mark should be securely attached to the boiler head opposite each water glass on a level with the center of the bottom gage cock and the lowest reading of the water glasses and project through the jacket not less than one inch. The purpose of the bench mark is to furnish a guide for the employees in replacing water gages and water columns in the enginehouse and shops.

After all the water-level indicating devices are applied the heights of the lowest indications should be checked by either of the methods described and it should be seen that the location of the lowest gage cock and the lowest readings of the water glasses coincides. The height of the crown sheet in a locomotive boiler cannot be termed as permanent due to service conditions and repairs, and while we have discussed the application of a crown-sheet badge plate to the back head, it is our recommendation that the crown-sheet height on all new locomotives be rechecked after 60 days service and also that the height of the lowest gage cock and lowest readings of the water glasses and the height of the low-water-alarm drop pipe above the highest point of the crown sheet be checked by the method for locating these parts after the application of a new back tube sheet or renewal of the firebox. Any differences found in these heights, from those previously existing, should be corrected.

The report was read by Chairman E. B. Gilley, general boiler foreman, Grand Trunk Western.

The Longitudinal Cracking of Flues through the Beads

Committee report gives metal fatigue as primary cause, lists the contributing factors, and suggests possible remedies

The cracking of flues and tubes longitudinally through the bead is commonly called fire-cracked beads. It is our opinion the primary cause is metal fatigue. This metal fatigue, therefore, is the main problem and to prolong the life of the material and govern the amount of service we obtain from it before it reaches this fatigue limit, we must find and do all possible to correct the contributing causes, some of which we enumerate together with possible remedies:

Expansion and Contraction

These are the stresses that actually produce the cracking after some or all of the other contributing causes have destroyed the ductility qualities, and set up strain hardening. As it is always present throughout the boiler from the time engine is fired until the fire is drawn and the boiler is cooled down, we should endeavor to control any drastic changes in temperatures during these operations. As the flues and tubes are of thinner material than the boiler or firebox plates, care should be exercised to prevent admittance of cold air to them by closing ashpan dampers, keeping the fire door closed, restrict use of blowers, and cover smoke stacks to insure against drastic contraction. Boilers should not be crowded and pressure raised too rapidly when firing them up.

Excessively Large Beads

When too much stock is allowed for beading purposes resulting in large, high beads, the water back of flue sheet does not absorb the heat from the crown of beads fast enough, which results in an overheated condition of beads, destroying ductility.

Some roads have adopted the practice of counterboring their flue sheets, flaring and welding flues flush with face of sheet to keep all the metal as close to the body of water in the boiler as possible, with some success as a prevention for cracking. It is felt by designers and builders of locomotive boilers and different mechanical engineers contacted, that this practice should not be adopted in high-pressure boilers on account of taking too much cross-sectional area away from flue sheet and weakening bridges between the flue holes. The committee feels that $\frac{3}{16}$ in. to $\frac{1}{4}$ in. should be allowed for beading purposes.

Water Conditions and Scale Formation

In nearly all cases where trouble is experienced with

fire-cracked beads, it is felt that formation of scale or deposits of mud at the back flue sheet is a large contributing factor. Deposits of mud or scale formation adhering to the flue sheet and flues restrict heat transfer and beads overheat under ordinary firebox temperatures.

It is obvious that the proper remedy for this condition is to treat the water, taking out the scale-forming solids. One remedy, which will prolong the life of beads, is to prosser the flues and tubes lightly at intervals to loosen this scale.

Flue Bridge Design and Layout

It is felt by many, especially the boiler maintainers, that the engineer designing the boilers is too prone to obtain the greatest amount of flue gas area, sometimes crowding in flues till the water space between tubes and flues is too small and with a small accumulation of scale on the tubes and flues, circulation of water is restricted, heat is not absorbed fast enough, allowing the beads and flue ends to become overheated.

It would be our suggestion that consideration be given to spacing the flues in flue sheets with as liberal a bridge as possible, retaining as large a water wall as possible between the flues and tubes. Also, where possible to obtain sufficient flue-gas areas, flues and tubes should not be staggered so they cannot be readily washed out between the rows.

Method of Application

It is generally felt that the conventional methods of setting the flues with sectional setting expanders, rolling, prossering, and beading does its bit toward the development of fire-cracked beads, in that these operations are all performed on the cold material and the cold working may produce tensional forces in the metal and certain cracking forces are present, before putting the flues or tubes in service after being applied.

Several practices have been established which, in most cases, contribute to lessening the fire cracking of beads. The following methods, as adopted, we consider to be especially helpful in that the cold working of material is reduced to a minimum and no doubt, some of the incipient cracks, not visible to the naked eye, prevented.

Making a corrugation, similar to the prosser crease in superheater flues, with a roller or corrugating machine while the flue is hot and being prepared for application is one method.

Another practice is that of flaring or belling the tubes with a flaring type roller instead of using the conventional flaring tool with air hammer or pining them over with a hand hammer.

Another one recently adopted, which looks promising, is the use of a type of roller expander which both rolls in the corrugation back of flue sheet and flares the tube preparatory to beading.

Some roads have discontinued the use of copper ferrules, it being thought eliminating the copper protruding through the flue sheet into the water space reduces the possibility of catching and holding the scale formation at the joint where flues or tubes enter the flue sheet and also because it is the practice of most railroads to seal weld the beads on initial application, it is thought a better job of autogenous welding is obtained. While this practice has its good qualities, the chairman of this committee has flues and tubes applied with and without copper ferrules and can see very little, if any, improvement in the fire cracking of beads.

Method Employed in Safe Ending and Annealing

Another practice which appears to contribute to lessen the tendency for fire cracking is the method used in cutting tubing to length and for safe-ends. In some instances it was found that saw cutting was conducive to a greater amount of fire cracking due to the rough edge and the very small, minute cracks left in the end of the tube. The practice of cutting safe ends on a lathe and polishing the ends unequestionably greatly minimizes the danger of incipient cracks, which later open up in service.

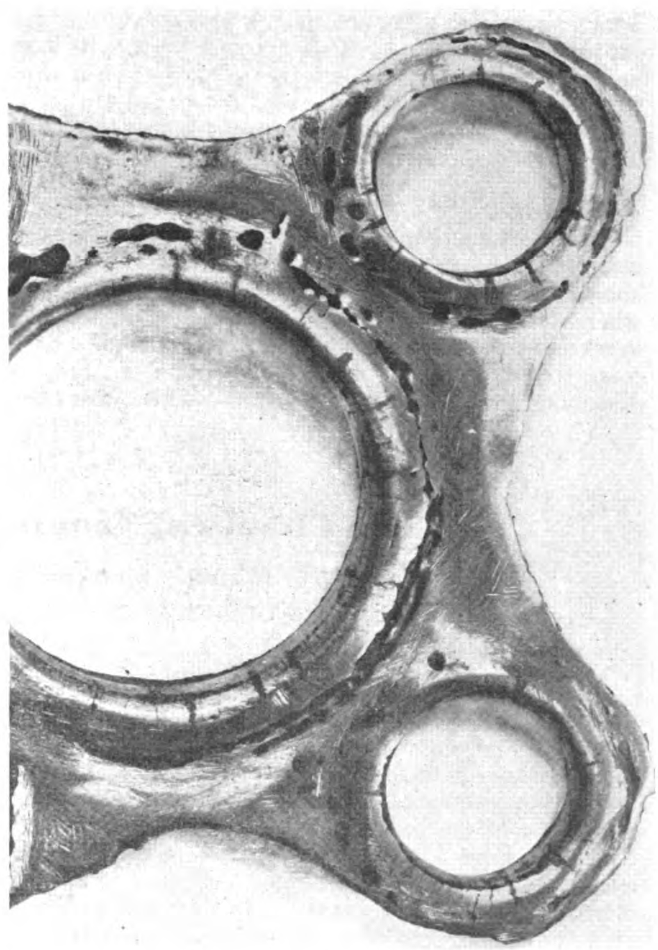
It is also felt that proper precautions are not always followed in annealing flues and tubes and that if more care were taken in heating the ends of flues and tubes to proper annealing heat and more precaution taken in protecting the ends from cold air or drafts, a more satisfactory service could be obtained.

It is suggested the proper heat for annealing purposes should be determined by the composition of the flues. With the ordinary standard steel flues and tubes, a medium cherry red, 1,250 deg. F., is considered proper.

Electric Welding of Beads

There are many who feel that seal welding the flue and tube beads to flue sheet is largely responsible for fire cracking and we feel, that in many cases, it is. However, if all operations in connection with the flues and tubes are properly handled and performed, welding is no more responsible for fire cracking than any of the other causes.

If the copper ferrule is used and not set back the proper distance from face of flue sheet there is a great possibility of it becoming mixed with the weld metal, causing intergranular brittleness resulting in cracking of the flue bead. The remedy for this type of cracking is



Fire cracks in flue and tube ends, firebox side, removed from a boiler having a working pressure of 300 lb. per sq. in. after 150,000 miles

to set the copper ferrules back from the face of flue sheet for a distance of $\frac{1}{32}$-in.

This is another reason why eliminating the copper ferrules is an advantage. If too much stock is allowed for beading purposes, you have already set up a cause for cracking, account of too much metal resulting in overheating and with the addition of welding material, the condition is aggravated. Smaller beads and just enough material for sealing purpose is the remedy.

In welding cold-worked material certain cracking forces are present in the tube metal before welding begins. These forces are the result of previous cold working such as rolling, beading and expanding. Cold working may produce tensional forces in the metal; then where a part of this metal is softened by welding, it is stretched apart by the tensional forces in the adjacent metal. Flues and tubes should be seal-welded with welding wire of $\frac{1}{8}$-in. diameter to insure against excess metal being deposited. The kind of wire best suited for seal-welding is a matter of personal opinion, but we feel that a straight polarity wire should be used to keep the heating qualities as low as possible.

Care, also, should be exercised to see that flues, tubes and flue sheets are properly prepared. It is good practice to sand blast new sheets before applying flues to remove the mill scale. Old sheets should be ground off and be free from grease. The success of your welding depends largely on setting up a good, clean job to insure against an excessive amount of heat being used in the process of welding.

The practice of welding tube beads while the boiler is empty of water to prevent any abrupt temperature changes also seems to help in overcoming fire cracking. Tubes should be tightened by prossering with sectional expander, at intervals. This not only serves to loosen the scale and keep the mud from working back to the weld which causes an overheated condition, but it also serves by keeping flues tight to relieve to some extent the stress on the weld.

Fuel and Honey-Combing

There are certain kinds of fuel which causes the honeycomb to form over and onto flue beads. This honeycomb adheres to the crown of flue beads and, where leakage is absent, is in a molten state. This overheats the beads causing them to feather out and become rough, producing a burnt condition of beads and destroying their ductility. Any improvement that can be made to reduce honeycomb forming will have its effect on prolonging the life of flue beads.

Arch Setting and Drafting

Proper brick arch setting and drafting of locomotive boilers will tend to reduce fire-cracking of beads in that the gases passing over the arch will be evenly distributed over the entire flue area.

An arch so arranged or set in a firebox to cause the gases to concentrate over a certain area of flue sheet is similar to a blast and will overheat or burn flue beads.

Firebox Temperatures

Uneven firebox temperature causes the unequal expansion and contraction of the portion of the flue directly in the back flue sheet while the bead is held firmly to the flue sheet by electric weld. Therefore, while engines are in service, every effort should be made to maintain the steam pressure constant. Reasonable care should also be taken in cooling the boiler gradually to as near the same temperature of washout water as possible before washing operations are started.

All the contributing causes enumerated and discussed do their part toward setting up conditions making it possible for the expansion and contraction stresses to bring about metal fatigue.

Discussion

B. C. King, general boiler inspector, Northern Pacific, stated that tests have shown that the cracking of flues can be prevented by the proper treatment of the boiler feedwater.

L. R. Haase, district boiler inspector, Baltimore and Ohio, said high temperatures at the back flue sheet are responsible for the cracking of flues, and that this condition is not found where the heat is better distributed and not localized.

C. A. Harper, general boiler inspector, Cleveland, Cincinnati, Chicago and St. Louis, discussed the importance of the method used in cutting safe ends to eliminate the starting of checks, and of the beneficial results obtained by cutting them in a lathe although this method was more expensive than sawing.

A. F. Stiglmeier, general boiler department foreman, New York Central, however, said that while compression tests on safe ends that have been cut by sawing indicate checks are developed by this method of cutting, a saw in proper condition will eliminate this trouble.

The Chemical Treatment of Boiler Feedwater

Committee report also indicates the importance of the proper blowing down and washing of boilers to control the concentration of dissolved solids

In introducing the reports of the other members of the committee, the chairman, C. W. Buffington, Chesapeake & Ohio, described the various methods of water treatment and pointed out that one of the biggest steps in the improvement of water conditions followed the realization of the importance of proper blowdowns.

On the Pere Marquette, Nalcometers are located at terminals and are used for rapid determination of dissolved products in boiler water. In this way the amount of water to be blown from the boiler is established. On the Louisville & Nashville the automatic blow-off has eliminated foaming. Wash-outs have been reduced from three- to eight-day periods to 30-day periods.

M. V. Milton presented the wash-out instructions used on the Canadian National.

F. Yochem of the Missouri Pacific recommended the elimination of the dome and the use of the perforated dry-pipe steam collector to reduce the heavy flow of steam into the dome.

Reports were included on this subject from M. Manley, for the Louisville & Nashville; R. W. Seniff for the Alton; A. D. O'Neill for the Pere Marquette; M. V. Milton for the Canadian National; F. Yochem for the Missouri Pacific, and E. Crapper for the Argentine Railways. The following is an abstract of the report from the Alton:

Water Treatment on the Alton

Before 1921 there was one lime-soda water softening plant at Bloomington, then the most important and hardest water supply on the line. The remainder of the water was treated quite ineffectively with various forms of boiler compound. Most of them were essentially soda ash and, properly used, would have prevented scale and corrosion. The experiences on the Alton during those years have been the experiences of many who have attempted treatment with simple compounds including soda ash. It was a classical example of how not to treat water. Samples of scale removed from Alton boilers in 1921 are shown in Fig. 1 and some of the corrosion found on flues as well as some other parts of the boilers is illustrated by Fig. 2.

In 1922, Alton water treatment was organized on a systematic basis under the supervision of a chemical engineer and an assistant whose sole duties were improvement of locomotive boilers through water conditioning. Soda ash proportioning units were installed at practically every water station where non-carbonate hardness existed. For some reason unknown to the author, the lime-soda plant at Bloomington had been removed and soda ash only was substituted.

The fundamental principle involved in the treatment was that non-carbonate hardness was the chief offender in scale formation and if it were destroyed and precipitated as a non-adherent sludge by the use of soda ash, the carbonate hardness which is destroyed by heat alone, would also be precipitated in the boiler where both could be blown off as sludge. It is doubtful if the corrosion problem was given any serious consideration at that time.

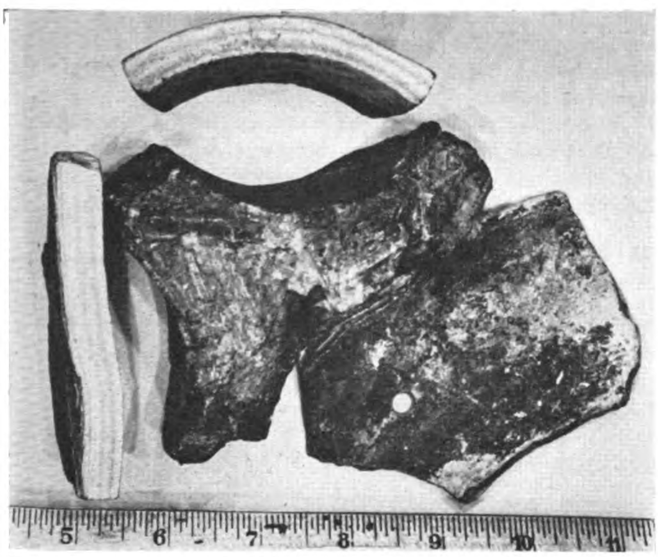


Fig. 1—Boiler scale—Inadequately supervised water treatment

The men in charge of the water treatment know that a chemical reaction is a definite and precise thing; that a definite amount of soda ash is required to destroy a given amount of non-carbonate hardness. They based their treatment on this fact, adhered to it, and it succeeded where previous attempts had failed.

During the years 1922 to 1927 there was a gradual improvement in boiler conditions but they did not improve as rapidly as they might have because corrosion continued at what seemed an accelerated rate. Boiler failures were practically eliminated during this period but maintenance, although reduced, still was rather high. By comparison with the period before 1922, conditions were considered good. The scale problem had been solved but the corrosion problem remained. During that period only slightly more soda ash than that needed to destroy the non-carbonate hardness had been used. Since the soda ash itself is destroyed when it reacts with the non-carbonate hardness, very little soda ash was left in the boiler water. At that time, this was thought proper because it was believed that excess soda ash had some mysterious effect of greatly increasing the foaming tendency of boiler water. Numerous service tests were made to determine the magnitude of this effect. Logically enough, but still much to our surprise, it was found that it had no more practical effect than boiler-water soluble solids already existing in the natural water supplies.

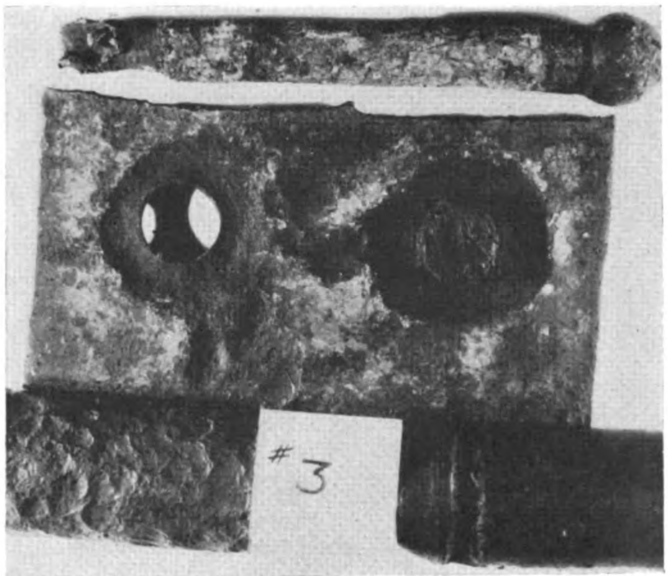


Fig. 2—Boiler corrosion—Inadequately supervised water treatment

Checking Corrosion

In 1927 it was decided to increase the amounts of soda ash added at points where passenger engines took water in order to secure a rather high excess of soda ash amounting to about 30 per cent of the soluble solids remaining in the boiler water after the non-carbonate hardness was destroyed. The purpose was to retard the

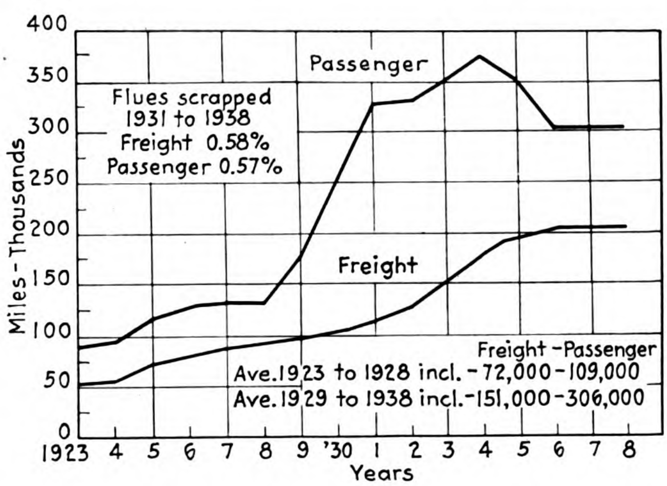


Fig. 3—Yearly average of locomotive miles between shopping for tubes

rate of boiler corrosion by increasing the alkalinity of the water in the boiler. Beneficial results were soon noticed and are clearly shown on the passenger engine graph, Fig. 3. The increased treatment was then extended to all water stations and the freight engine boilers also began to show the benefits. See the freight engine graph also shown on Fig. 3. These graphs show quite clearly how mileage between removal of flues was increased, first by the addition of only slightly more soda

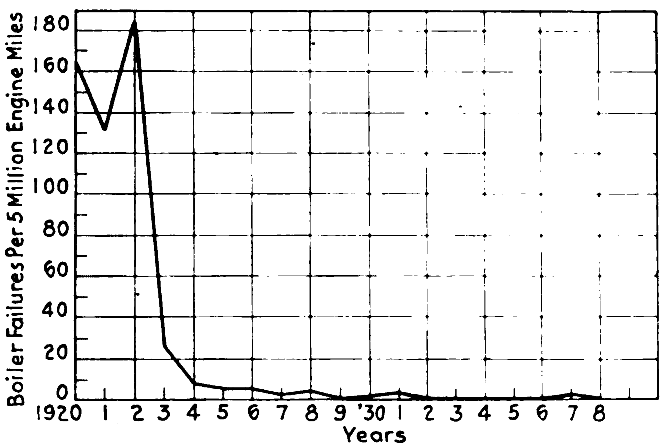


Fig. 4—Boiler failures resulting from scale or corrosion

ash than necessary to destroy the non-carbonate hardness and then later by the further addition of sufficient excess soda ash to give relatively high boiler-water alkalinities. The remarkably low percentage of flues lost because of corrosion is further evidence of the success of this procedure. It should be understood that the percentage of flues scrapped, shown on the graph, includes all flues at enginehouses as well as at the boiler shop at flue removal periods.

There was no increase in foaming trouble during this period; in fact this difficulty actually diminished. Some very interesting phenomena were discovered during an investigation of foaming tendencies during the years succeeding 1927 but their description does not properly belong in this report. One item only deserves mention here. Careful service tests have indicated that there is no difference in the foaming tendencies of the average water supplies between the Mississippi river and the Appalachian mountains in the northern half of the United States, whether treated with soda ash or limesoda, except in the case of sewage and excessive natural mud. In 1928, boiler washout periods at all points except one were extended to 30 days and a very definite improvement in boiler conditions resulted. There was a marked decrease in boiler cracking of all kinds and the boilers were also cleaner.

Eliminating boiler washouts to secure cleaner boilers seems like a contradiction but that is exactly what happened. The explanation is rather simple. The boiler water carries not only a considerable concentration of dissolved solids but also sludge. Some of both of these remains on the boiler surfaces as the water is drained out and. these surfaces being warm, dry off fast enough to leave this material adhering to them even though the washing is done according to the best practice with the least possible delay. Where a direct stream of water from the washout nozzle strikes this material most of it washes off, but in the other parts of the boiler it remains.

Results of Treatment

The peak for passenger locomotive mileage between shopping for flues, as shown by Fig. 3, was reached in 1934. The limiting factor was the number of miles the locomotives could make in the period allowed on flues. The decrease in mileage between flue removals for passenger engines after 1934 is the result of limiting requests for Federal extensions of time to those flues which had not run more than 250,000 miles since application. Freight engine mileages, not affected by these limitations, continue to increase. Improvement in other boiler conditions kept pace with the improvement in flue conditions. The decrease in boiler failures is shown by Fig. 4. Firebox renewals decreased as shown by Fig. 5.

Federal extensions of time on flue removal dates made high flue mileages possible because on the Alton, 100,000 miles for a passenger engine and 50,000 miles for a freight engine per year is high. Since 1930, 139 first and 36 second extensions of time on flues have been granted. Thus in eight years, 175 years of flue service between removals have been gained. On the basis of locomotives owned (169 at the present time), this is equivalent to one full year of boiler service gained between shoppings in the eight-year period. On the mileage basis this amounts to over 5,000,000 miles gained. Sixty-five extensions were granted on Alton flues in 1933. Not a single extension request was refused. This was 5.07% of all extensions granted that year in the United States. According to the number of engines in service on the Alton compared with the total in service in the United States, this was about 16 times as many extensions as the average railroad in the country received that year. Not one of the engines on which the Alton requested an extension of time on flues had a single flue removed because of corrosion or scale.

A number of passenger engines have run between 400,000 and 500,000 miles between flue removals; one ran nearly 600,000. This was a Pacific-type engine carrying 220 lbs. per sq. in. steam pressure with 22-ft.

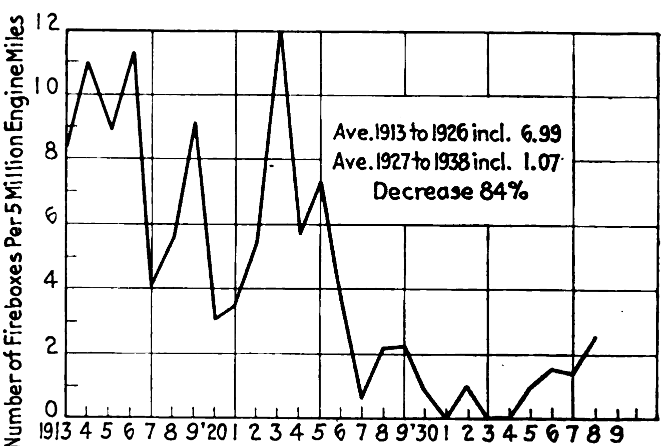


Fig. 5—Firebox renewals per five million locomotive miles

flues. Its schedule was a round trip of 597 miles daily between Chicago and St. Louis. During the six-year period these flues were in service not a single one was removed because of corrosion or scale. Some idea of the condition of these flues and the firebox after running 598,000 miles can be gained from Fig. 6, showing the side sheet, and Fig. 7 the boiler interior looking forward The flues, when removed from this boiler, were found in such good condition that all were safe ended and reapplied. They have just completed an additional 400,000 miles, making practically a million miles in all. Samples taken from them were found to meet the American Society of Testing Materials specifications for physical tests for new tubes. It is interesting to note that boilers operating with 350 lb. steam pressure on the Alton Rail-

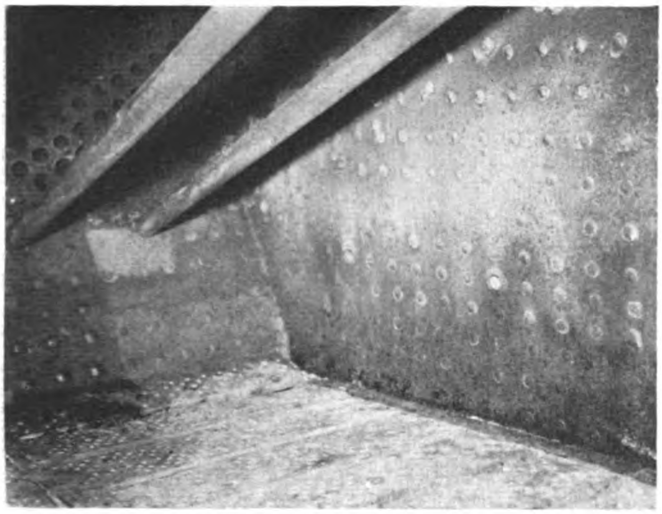


Fig. 6—Side sheet after 598,000 miles

road remain cleaner than those carrying 200 and 220 lb. pressure.

Present Status of Treatment

Soda ash has been the only chemical used for prevention of boiler scale and corrosion. Since 1936, commercial tannin has been used at a few water stations to keep locomotive branch pipes and injectors clean. In 1938, Alton locomotives ran 6,049,000 miles using 1,179,000,000 gallons of water treated with a million pounds of soda ash. The cost of all items in connection with treatment was $0.02511 per 1,000 gallons.

Almost every railroad has a few points where water containing non-carbonate hardness is still used, where corrosion still gives trouble, and where cheap efficient treatment is desirable. Soda ash proportioning units are cheap, comparatively simple to operate and are easily moved in case of abandonment of water stations. Soda ash will give as satisfactory results as any other form of treatment, if correctly and judiciously used. The data presented in this paper are offered in support of this contention. It would seem that its use is indicated at water stations at which the water contains even relatively small amounts of non-carbonate hardness where: (a) Natural mud and sewage are not excessive; (b) financial considerations make more expensive treatment and treating plants undesirable, (c) especially at intermediate water stations now without treatment on divisions where the major water stations are already furnished treated water.

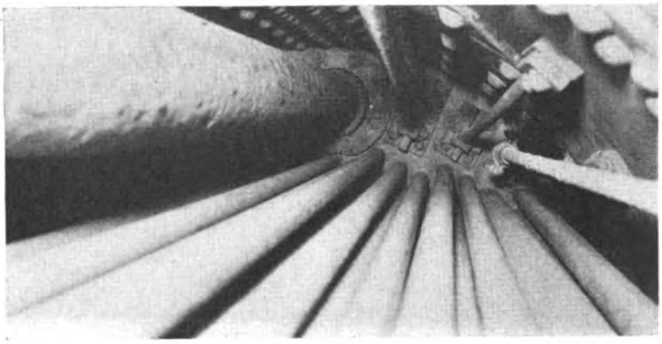


Fig. 7—Interior of boiler after 598,000 miles

One absolutely necessary adjunct to successful water treatment is properly trained technical men. Unless the railroads are willing to assume the small proportional expense involved for such supervision, they should not expect optimum results.

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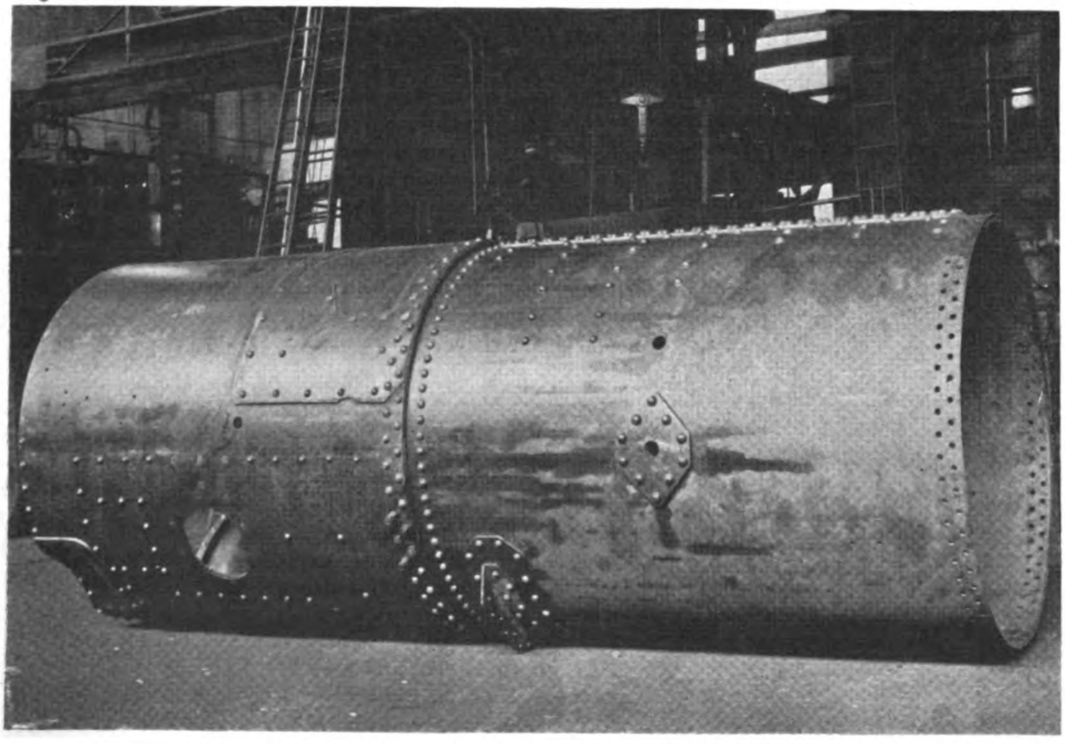


W. E. Dunham
First Vice-President

C. J. Nelson, President

J. S. Acworth
Second Vice-President

Meeting of

Car Department Officers

Well-attended sessions of the association at Chicago hear constructive addresses and committee reports

THE annual meeting of the Car Department Officers' Association, held at the Hotel Sherman, Chicago, October 17-19, was notable for excellent attendance and the generally constructive character of the individual addresses and committee reports presented. While the attendance at any of the sessions seldom exceeded 200, the total registration was 330, including both railroad and supply company members.

With President C. J. Nelson, superintendent, Chicago Car Interchange Bureau, presiding, the association was favored with individual addresses on foremen training, by L. W. Baldwin, chief executive officer, M. P.; the proper functioning and potential importance of the association, by F. G. Gurley, vice-president, Santa Fe, D. S. Ellis, chief mechanical officer, C. & O., and K. F. Nystrom, mechanical assistant to chief operating officer, Milwaukee; car conditions which need to be corrected, by D. J. Sheehan, superintendent motive power, C. & E. I.; the human factor in car work, by R. V. Wright, managing editor, Railway Age; the prevention of loss and damage, by C. H. Dietrich, executive vice-chairman, Freight Claim Division, A. A. R.; and private car operation, by Leroy Kramer, vice-president, General American Transportation Corporation.

Committee reports were presented on the following subjects: Membership, Chairman J. S. Acworth, supervisor of equipment, General American Transportation Corporation, Chicago; Publicity, Chairman E. L. Woodward, western editor, *Railway Mechanical Engineer;* Freight and Passenger Car Construction and Maintenance, Chairman J. McMullen, superintendent car department, Erie, Cleveland, O.; Shop Operation, Facilities and Tools, Chairman J. A. Deppe, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.; Passenger Train Car Terminal Handling, Chairman G. R. Andersen, supervisor of car maintenance, Chicago & North Western, Chicago; Lubricants and Lubrication, Chairman J. R. Brooks, supervisor lubrication and supplies, Chesapeake & Ohio, Richmond, Va.; Freight Car Inspection and Preparation for Commodity Loading, Chairman F. G. Moody, master car builder, Northern Pacific, St. Paul, Minn.; Interchange, Chairman M. E. Fitzgerald, master car builder, Chicago & Eastern Illinois, Danville, Ill.; Loading Rules, Chairman H. H. Golden, supervisor, A. A. R. Interchange and Accounting, Louisville & Nashville, Louisville, Ky.; Billing for Car Repairs, Chairman D. E. Bell, A. A. R. instructor, Canadian National, Winnipeg, Man.; Painting, Chairman L. B. Jenson, passenger shop superintendent, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.; Nominating, Chairman J. E. Keegan, chief car inspector, Pennsylvania, Chicago.

President Nelson's Address

Following the joint session address by L. W. Baldwin, as reported elsewhere in this issue, Mr. Nelson delivered his presidential address and emphasized among

A. J. Krueger
Third Vice-President

F. L. Kartheiser
Secretary-Treasurer

E. S. Smith
Fourth Vice-President

other things the possibility of large savings through more careful selection of cars for commodity loading, reduction of cross hauling, more effective and economical maintenance methods, increased knowledge of how to apply the highly important rules of interchange and loading, and the provision of equipment in better mechanical conditions to prevent loss and damage to freight. President Nelson called attention to the need for training younger men engaged in car department work and particularly developing an adequate force of experienced, competent supervisors to take charge of this important phase of railroad activities. He said that the association is national in scope and offers a common meeting ground for car men representing both the railroads and the private car companies, hence being adapted to develop constructive information regarding detailed car maintenance practices and problems not commonly considered by the Association of American Railroads, Mechanical Division.

F. G. Gurley said he was glad to offer every encouragement and assistance possible to the Car Department Officers' Association, both because of the desirable objectives of the association and because of the important part which members of the association play in efficient railroad operation. He referred to the vast improvement in car equipment from a maintenance standpoint, due to modern construction and said that the railroads now face the problem of satisfying more particular shippers who demand better cars and better service and who must be given what they want and made as "railroad-minded" as possible. In concluding his remarks, Mr. Gurley said that he was impressed with the frankness and fearlessness which the Car Department Officers' Association displays in discussing certain problems, a frankness and fearlessness not equalled or certainly not exceeded by any other organization. He urged the continuance of this characteristic if the association is to develop its maximum usefulness.

D. J. Sheehan called attention to a considerable number of specific instances in which desirable freight car maintenance standards, as well as A. A. R. loading and interchange rules are not being adhered to, with attendant serious increase in operating and repair costs, as well as loss and damage payments, not to mention dissatisfied shippers. He said that in the past two months thousands of freight cars have been returned to railroad service, many of them not being suitable for handling the commodities for which they were built, and cited, as instances, composite gondola cars offered for coal shipments with a high percentage of the side planks broken, flat cars placed for machinery loading with decks seriously defective, etc. He expressed the opinion that car department officers have a definite responsibility in keeping the general officers of their respective railroads acquainted with unsatisfactory car conditions. He said that they must be conscientious in their duties and have the courage of their convictions, not permitting cars to remain in service if unfit for loading and, by the same token, not marking any cars "bad order" which are fit to move commodities on the rails.

Mr. Sheehan closed his address with the following paragraph: "There is another responsibility which rests on the shoulders of car department officers and I believe this responsibility overshadows all others. The officers of the car department are charged with the responsibility of maintaining the rolling stock of the railroads in a safe condition to operate. When a passenger train leaves Chicago with its human cargo to go thundering at high speed over the rails, a car department officer, or one of his employees, is the last man to pass his approval on the safe condition of that equipment. When a freight train is made up at a terminal and before it starts on its journey through the night, a car department officer or his employees must know that the lives of those men who are operating that train, and the commodities carried, are properly protected in so far as equipment is concerned. . . ."

Election of Officers

At the conclusion of the committee reports, the following officers were elected to supervise the affairs of the association during the ensuing year: President, J. S. Acworth, supervisor of equipment, General American Transportation Corporation; vice-president, A. J. Krueger, superintendent car department, New York, Chicago & St. Louis; vice-president, E. S. Smith, master car builder, Florida East Coast; vice-president, F. E. Cheshire, general car inspector, Missouri Pacific; vice-president, G. R. Andersen, supervisor of car maintenance, Chicago & North Western. F. L. Kartheiser, chief clerk-mechanical, Chicago, Burlington & Quincy, was re-elected secretary-treasurer. In accordance with the new constitution adopted by the association this year, retiring president C. J. Nelson, superintendent, Chicago Car Interchange Bureau, becomes chairman of the Board of Directors.

Loss and Damage As Influenced by Car Condition

By C. H. Dietrich

Executive Vice-Chairman, A. A. R., Freight Claim Division

It is not possible from the statistics we gather to say which of the several principal defective conditions results in the greatest amount of damage, but we can say rather authoritatively that unless a car is proof against leakage from rain and snow storms, which necessitates a reasonably tight roof and snug fitting side doors, and is likewise free from contamination of grease, oil and other similar contaminating commodities, together with freedom from protruding nails and bolts, there is a great likelihood that damage to some extent will accrue to most classes of merchandise and freight loaded therein. Therefore, these three classes of defects may well be put on the car men's must list in his manual on what constitutes adequate equipment.

As an indication of what can be done along these lines I recently received a statement from one of the largest flour mill companies in the country on their 1938 experience, which shows that from all of their mills in the United States 96.5 per cent of the cars they loaded reached destination without damage, and at one particular mill during the month of September showed a record of 99.07 per cent of the cars loaded reached destination without damage. For the entire year of 1938 defective equipment is charged with $164,848 to flour and other mill products, indicating that all millers do not give the same attention to the equipment they load as does the one making this report.

Large Claim Payments Due to Defective Equipment

In glancing through the year's summary it is rather surprising to note the cost of defective equipment furnished for loading coal and coke, which is ordinarily handled in open top equipment, on which claims to the extent of $193,667 accrued charged to this cause. The probability is that the greater part of this amount was chargeable to defective hoppers. The largest item in the account for 1938, so far as defective equipment is concerned, is that involving bulk grain, and here we have a loss and damage of $229,200 principally due to leaks through floors, sides, grain doors, etc. Getting down to defects more commonly associated with those mentioned above we find that sugar was damaged to the extent of $67,646 last year and this is divided equally between snagged sacks, damage account of wet from leaky roofs and contamination due to cars not having been properly cleaned.

The fruit, melon and vegetable group cost carriers approximately $100,000 account of defective equipment, and with the exception of watermelons I think it is a fair statement to make that the bulk of this damage is brought about because of improper refrigeration or protection against frost due to leaky car doors or ice plugs, that is, doors and ice plugs that do not fit snugly.

There is, perhaps, as you gentlemen know better than any other group of railroad men, a tremendous number of cars, both insulated and non-insulated, in service today that are not suitable for the loading of all commodities, and because of this situation there is a greater need than perhaps ever before for care in selecting cars for the commodity to be loaded. To what extent the car man can interest himself in this selection program, I am not sure, but I do believe it is a subject which you might with profit docket in order that the subject itself might be given the consideration due it by such organizations as has to do with this matter, particularly the Freight Station Section of the A. A. R., the Superintendents Association and any others that are responsible for the careful selection of equipment for the particular load intended.

Improperly-Fitted Refrigerator Car Doors and Hatch Plugs

For the past several years, and at the present time, all lines engaged in handling fresh fruits, melons and vegetables in volume are being confronted with a growing number of claims for damage allegedly due to improperly refrigerated cars; the failure being charged to the fact that daylight is observed over or under the padded side doors or padded ice plugs. Our freight claim officers are inclined to challenge this complaint on the theory that any such infinitesimal amount of outside air seeping into cars through these openings could not possibly affect the inside temperature of cars. There is a great deal of expert opinion on the other side of this problem, and it is, therefore, quite important that this particular feature be given the attention of car men having to do with the maintenance of all insulated equipment.

Another very troublesome feature which perhaps does not run into extensive money damage, but does cause no end of controversy is the failure of many present day refrigerated cars to protect the contents against excessive cinders when shipments move under ventilation. In a long discussion with a large shipper recently the statement was made by him that there is a wide difference in the size of the mesh of screens placed in the car bunkers for the purpose of keeping out cinders. If this is true the carriers could save the payment of many claims, and especially the complaints from many claimants, by having these screens renewed with a mesh as small as possible without interfering with the ventilation qualities of the car.

With respect to the matter of damage associated with defective and inadequate running gear. This may not be the right designation, as I think the draft rigging is perhaps the most important part of a car so far as its relationship to damage to freight is concerned. To appreciate the importance of draft gear we must again refer to our statistical analysis of the loss and damage account from which it is observed that out of the 21½ million dollars expended in 1938, causes that have to some extent a close connection with the draft gear account for approximately 12 million dollars, or considerably more than one-half of the entire account. These causes are listed as unlocated damage together with improper handling in trains, yards or stations.

It is doubtful whether the average train man, whether he be employed in terminal or road haul work, has much detailed knowledge of the mechanisms of a draft gear, and especially is he in the dark on the fact that when the impact received in switching reaches four miles per hour, or thereabouts, even the most modern of our draft gears close and shocks in excess of this amount are taken with practically the same effect as though no draft gear protection was furnished at all.

Prompt Repairs Are Essential

With further reference to the matter of damage associated with defective and inadequate running gear, I would be remiss in my duty if I failed to commend your

organization on what has been done during the past few years to overcome unnecessary delays to loaded cars through organizing at important terminals, particularly at interchange points, the prompt repair of cars that are cut out by inspectors in connection with rules governing the interchange of equipment. This, of course, is particularly applicable to carload shipments of perishable freight where failure to maintain schedules almost universally results in a claim for either deterioration or market decline.

There are many other angles to the relationship between loss and damage and equipment which my time will not permit an enlargement upon, but I will be more than satisfied if through this brief summary of the situation an active interest is initiated among the membership of your organization to the possibilities of the rank and file of your membership being in position to improve the services of the railroads, which serves a double purpose, i. e., satisfying patrons and is economical to the railroads through the prevention of loss and damage. There was never a time in our whole history when improved service and satisfied patrons was of greater importance than today due to the competitive forms of transportation we are undertaking to cope with.

Report on Interchange

After careful consideration of many questions submitted, your committee makes the following recommendations for rule changes, or interpretations:

A. A. R. Rule 3

Question: Referring to Rule 3, sec. (c), items (7), (8), and (9), do these paragraphs as now written prohibit the application of connections between the operating lever and the coupler, composed of links, clevices, etc., on cars built new or rebuilt after Aug. 1, 1933?

Answer: No. See Par. (8). However, we recommend that Par. (9) be revised to read: "Coupler operating LEVER of the rotating type handle (which pulls out and up through an arc, similar to type shown on Plate B of the United States Safety Appliance Specifications) AND connected direct with coupler lock or lift without the use of links, clevices, clevice pins, or chains, required on all cars built new or rebuilt on or after Aug. 1, 1933. From owners."

Reason: Note 1. The word "rigging" of old Sec. (9) is changed to "LEVER" to clarify, and our suggested change sets forth that the rule now clearly applies to the direct connections as well as the levers. Note 2. Plate B of USSA Specifications conflicts with current standards, inasmuch as it shows the use of clevices, clevice pins, and links, and further, the present rule does not cover cars built new or rebuilt after Aug. 1, 1933.

A. A. R. Rule 4, Section (G), Item (3)

Question: Many cars reach interchange with side door operating levers, door guides, front and rear stops broken or missing, and many cards are being issued to cover where there is no associated door or car damage. Question arises as to whether or not these missing or broken door devices are damaged by unfair usage, or due to defective material or weak design of the particular device. What action should be taken?

Answer: Appreciating the difficulty at points of interchange, and in order to expedite movement of cars and eliminate carding, your committee recommends rule change as follows: "Rule 4, Sec. (g), Par. (3): Defect card shall not be required for damaged push pole pockets, door operating levers, stops (front or rear), or bottom guides, door hangers, or parts thereof, when not directly associated with other delivering line damage."

Reason: To eliminate excessive carding for such damage and expedite interchange.

A. A. R. Rule 4, Par. (6)

Question: Having had so much trouble with the application of Rule 4, so far as it affects holes cut in cars for load securement in the past, and considering that the revision of Rule 4 as now proposed in Circular DV-952, dated 5-29-39, does not cover holes cut in sides or ends of composite cars, a specific provision should be made to cover, to eliminate delay and controversy at interchange.

Answer: Your committee concurs and recommends a new paragraph be added to Rule 4, as new Sec. (7), reading: "Wood sides or ends of gondola cars: Holes bored or cut exceeding 3 in. any direction."

Reason: To clarify rules.

A. A. R. Rule 23, Section 111, Page 82

Question: A member submits request that the building up of axle collars be prohibited, and submits joint statements showing eight such built up axles removed from foreign cars, covering sixty days' period record, show edges of collars broken away and seams at bottom of collar fillets, and other conditions developed which warrant the elimination of authority to so build up axles.

Answer: Your committee recommends that the authority now granted in Rule 23, Sec. 111, be eliminated and provide that axle collars should not be built up by welding.

Reason: The information developed and presented indicates a dangerous condition, conducive of hot boxes and burnt off journals, which should not prevail.

A. A. R. Rule 3, Item (11)

Question: In event a container car carrying a defect card, Rule 32 damage, is delivered in interchange with container missing, is such container cardable?

Answer: No. See Rule 32, Page 101, Interpretation Question 2. In such case car owner should trace for container.

A. A. R. Rule 49, Location (D) Card Receptacle

Question: Considering the many new cars now going into service, and the hazard incident to locating defect card receptacles when placed under car, should we not suggest a definite location on the exterior of car?

Answer: Your committee recommends that the last sentence of Rule 49 be changed to read: "When receptacle is used, same must be in accordance with A. A. R. recommended practice specification, applied one per car, located on exterior of car, preferably under car numbers at B end, right side of car, not more than 5 ft. 6 in. from top of rail."

Reason: To expedite the inspection of cars at interchange points, and in the interest of safety of inspectors.

A. A. R. Rule 58

Question: There seems to be a conflict as between Rule 3, Interpretation 4, Rule 58, and I. C. C. regula-

tions governing the interchange of cars. Can a loaded car be rejected if offered in interchange with end of train line broken off, angle cock and hose missing?

Answer: No. Repairs can and must be made without movement of car.

A. A. R. Rule PC-7, Item (J)

Question: There seems to be an error in present rule, in that it is not definite in the provision as to what must be done with UC brake valve out of date.

Answer: Your committee agrees, and suggests that the words "must be cleaned" be added after the words "standard markings" in Sec. (j), first paragraph.

Last year the committee made certain recommendations pertaining to making greater efforts toward complying with regulations adopted by the Association of American Railroads, and as a reminder we would again urge that more care be exercised in connection with the following details:

1. Accept responsibility for fire damage, flood damage, clam shell damage, Rule 44 damage, etc., by attaching defect cards to cars at the time and place where such damage originates, and thereby saving time and delay at interchange points.
2. Attach defect cards to cars at interchange points, and refrain from running cars with delivering line defects on record, which results in misplaced responsibility, and which is contrary to the intention of the A. A. R. interchange rules.
3. Make greater efforts to prevent cars from which loads have been transferred account being in defective condition of the car, from continuing in service without repairing the defects which caused the transferring of the load.
4. Make greater efforts to repair cars for loading by thorough cleaning and removal of residue, including band wire, blocks, etc.
5. See that cars offered for loading are in suitable condition for the load of the particular commodity for which they have been ordered; also make greater efforts to insure that material being loaded in open top cars is secured in accordance with the A. A. R. Loading Rules.

The report of this committee, containing recommendations for considerations by the A. A. R. Mechanical Division was signed by Chairman M. E. Fitzgerald, master car builder, C. & E. I.; J. E. Mehan, assistant to superintendent car department, C. M. St. P. & P.; H. E. Wagner, division car foreman, M. P.; A. C. Browning, representative A. A. R. Mechanical Division; W. A. Emerson, general master car builder, E. J. & E.; E. G. Bishop, general car foreman, I. C.; F. McElroy, Union Tank Car Company.

Discussion

[Rule changes or interpretations included in this report were approved by the association for submission to the A. A. R. Mechanical Division, with the exception of changes in three Rules No. 66, 68 and 84, which were either eliminated or deferred until next year's report. On account of space limitations, these three items are not included in the present abstract of the committee's report.—Editor.]

(The committee report was accepted.)

Report on Car Construction and Maintenance

The committee, after reviewing the many details connected with our subject, has been unable to develop much that could be deemed of value to the association at this particular time; however, the following recommendations are submitted for consideration:

Passenger Equipment: It is recommended that overhead water tanks be equipped with standard connections to permit access to them from both sides of the train.

Freight Equipment: It is recommended that consideration be given to prohibiting in interchange cars equipped with push-down type release lever, known as the Carmer type, as it is our opinion that the above type of pin lifter contributes to break-in-twos of freight trains.

On some tank cars it is necessary to place the jack under the sills in order to jack them, which is not only dangerous, but requires considerable time to do the work. Suggest consideration be given to an additional allowance in price for jacking this type of car, also that future tank cars be constructed with outside jacking plate at body bolster.

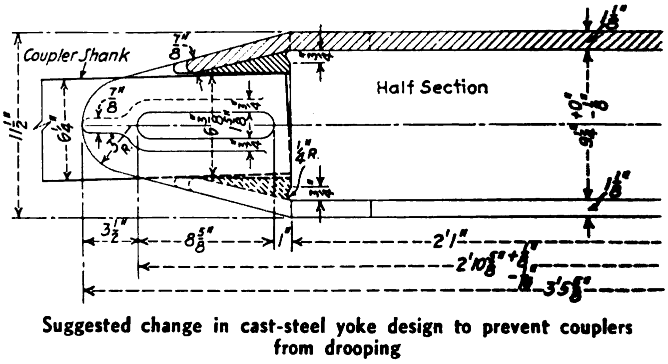
We continue to have trouble and complaints about drooping couplers. It is the opinion that this particular difficulty can be eliminated if the present type of cast steel yoke is changed so the butt of the coupler will shove into a pocket. There is considerable wear in draft keys, slots in center sills and the slot in the coupler, which allows coupler to droop, and it is the thought that if the yokes are made as shown in the drawing, the objectionable condition would be pretty well taken care of.

The report was signed by Chairman J. McMullen, superintendent car department, Erie; C. Claudy, master car builder, Grand Trunk Western; W. A. Bender, master car builder, Alton; J. R. Hayden, superintendent car department, Missouri-Kansas-Texas, and J. E. Keegan, chief car inspector, Pennsylvania.

Discussion

With regard to the recommended provision of jacking plates at tank car body bolsters, one member called attention to the fact that these jacking plates are already called for in the specifications, and another member confirmed the committee's suggestion that it would be a good idea to allow an additional price for jacking tank cars by the more difficult and dangerous method of placing jacks under the sills when outside jacking plates are not provided.

A member from the C. B. & Q. said that the modern coupler is unbalanced and any slack in the coupler shank connection to the yoke, as mentioned by the commit-



Suggested change in cast-steel yoke design to prevent couplers from drooping

tee, tends to permit the coupler to hang down and create the hazard of a possible train break-in-two. He stated that once a coupler head starts to droop slightly, subsequent service shocks keep driving it down until a dangerous condition exists.

(*The report was accepted without recommendations.*)

Billing for Car Repairs

The following is report of the Committee for Billing of Car Repairs, covering opinions of the members as expressed by replies received, as amended unanimously by the members present at the meeting held at Chicago, June 26th.

Some of the questions submitted to this committee have been referred to the Committee on Interchange, with such comments as represented the views of the members of this committee. It was felt that these questions were more properly subjects for the consideration of the interchange committee, and were such that their views might differ considerably from those of this committee.

No. 1—Rule 3: *Q.*—Would industrial and other non-interchangeable cars be exempted from the requirements of Sec. (b) (1)?

A.—Yes. Exemption from the requirements of Sec. (b) (2) would automatically cover Sec. (b) (1).

Rule 3 provides interchange cars built new on or after January 1, 1935, or rebuilt on or after August 1, 1937, must be equipped with No. 15 or No. 3 A. A. R. Standard brake beams. This rule also permits acceptance in interchange in initial movement from manufactured to destination of industrial or other cars not intended for interchange without meeting requirements of Rule 3.

No. 2—Rule 8: *Q.*—When repairs are made which are classed as temporary, is it necessary to furnish billing repair card when such repairs are not listed in Rule 108?

A.—Repair card must be furnished for all repairs made, except items listed in Rule 108, as outlined in first paragraph of Rule 8.

No. 3—Rule 16, 3rd Par.: *Q.*—While cars are stenciled "New Std" could car owner present claim for wrong repairs when repair card shows the former standard applied and removed?

A.—Yes, provided such claim was properly supported in accordance with requirements of interchange rules.

Recommended: that this paragraph be revised to provide for stenciling actual location of new standards.

Reason: If this is done the location at which new standards have been applied will be automatically protected against wrong repairs.

No. 4—Rule 17 (C) (4): *Q.*—In the event of changing draft gear stenciling is it the intent that the actual type of gear will be stenciled, or the words "A. A. R. Approved?"

Recommended: that this paragraph be clarified to specify the stenciling to be applied when first application of A. A. R. approved gear is made to cars stenciled for draft gear. Would the words "A. A. R. Approved" suffice, or should the name and type of gear be stenciled on car?

No. 5—Rule 23, Int. (3): *Q.*—Does this prohibition against changing coupler size or design by welding include welding plates to 8½ in. butts to bring them to 9⅛ in.?

A.—Yes. As the answer specifies that size or design of coupler cannot be changed by welding.

No. 6—Rule 23, Int. (3): *Q.*—Can couplers with pieces welded to sides be arbitrarily scrapped at owner's expense if not otherwise defective?

A.—No.

No. 7—Rule 32, Item (P) and Sec. (B) (3): *Q.*—Would safety appliances on tank cars damaged by operations covered by this item be owner's responsibility if car is not damaged to the extent shown in Rule 44?

A.—If car is not damaged to the extent shown in Rule 44 all defects (including safety appliance defects) would be owner's responsibility.

No. 8—Rule 49, Sec. (A): *Q.*—In the event of a receptacle being R&R account other repairs, would it be satisfactory to re-apply it at same location when such location does not conform to Section (a)?

Recommended: That note be amended to specify procedure to be followed when receptacle is R&R on account of other repairs. Note in question now reads as follows:

"Suitable receptacle referred to above may not be initially to or relocated on foreign cars except with consent for car owner."

No. 9—Rule 66, Item 12: *Q.*—Does this mean that hollow or corrugated back wedges should be scrapped when found in foreign cars, irrespective of whether they can be condemned under Sec. (k) of this rule?

Recommended: That the first paragraph of this item specify whether or not such wedges can be arbitrarily scrapped at owner's expense. If they should be so scrapped, we also recommend that Rule 65 show whether or not owner can be billed for the replacement of such wedges when changed in conjunction with the renewal of wheels and axles for which the delivering company is responsible.

No. 10—Rule 87, Sec. (D): *Q.*—Tank car running board is partially renewed and repair card shows 1½ in. thick applied, but does not show thickness of board removed. Owner claims withdrawal of charge on basis of 1¾ in. being proper repairs to comply with safety appliance regulations as per page 113 of the A. A. R. issue of U. S. Safety Appliances revised to January 1, 1935. Should repairing line withdraw its charge or should owner be required to furnish joint evidence to determine one or other of the following facts:

(1) That car was stenciled as built after May 1, 1917.

(2) That if car was stenciled as built prior to that date, the remainder of the running board was 1¾ in. thick.

(3) That 1½ in. was recorded on the repair card, while 1¾ in. was actual applied.

A.—Repair card in itself is not sufficient evidence of improper repairs, therefore claim of improper repairs must be supported by joint evidence executed in accordance with requirements of Interchange Rule 12.

No. 11—Rule 107 and Note Following Item 14: *Q.*—Can labor be charged for side bearings and center plates if material charge for bolster is made per item 188-B, Rule 101?

A.—No. Note following item 14 of Rule 107 applies only to cast steel bolsters. Item 188-B of Rule 101 covers a composite bolster and charge should be on weight basis, including weight of center plate and side bearings; no extra charge permissible for rivets securing these items.

No. 12—Rule 107—2nd Note Following Item 48: *Q.*—Does this apply to yoke support bolts or rivets, or

only to bolts and rivets which might have been removed in order to remove the long cross key irrespective of the yoke support?

A.—No. Only to the R&R or R of angle or plate used to prevent draft key from moving out of place.

No. 13—Rule 108 (A): Third item from the end of this section reads as follows: "Turnbuckles tightened (other than body truss rods)."

Recommended: That item covering turnbuckles be amended to permit labor charge for tightening anchor tank band turnbuckles in addition to body truss rod turnbuckles.

Reason: This is a substantial operation usually, for which labor should be allowed.

No. 14—P. C. Rule 10, and Note After Item 5: Q.—Is the Note under Sec. 5 intended to apply to all items in this rule?

A.—Yes.

Recommended: That note be relocated below item 6 to clarify the intent.

No. 15—P. C. Rule 22: Q.—Is it the intent of the second note at the end of this rule that forgings and iron or steel castings will be charged and credited on weight basis at the prices per pound in Rule 101?

A.—Yes, provided they do not come within the provisions of Rule 105.

No. 16—P. C. Rule 22—4th Note on Page 317: Q.—Can charge be made for repairing a passenger brake beam not RSS&T?

A.—Yes. Charge on basis of actual material applied less scrap credit at $0.005 per lb., plus actual labor for removing, repairing, and replacing beam.

The report was signed by Chairman D. E. Bell, A. A. R. instructor, C. N.; B. J. Jamison, assistant supervisor car inspection, Southern; R. W. Hollon, chief A. A. R. clerk, C. B. & Q.; E. S. Swift, assistant chief clerk, Wabash; W. E. Henley, general foreman car department, I. C.; and W. J. Burns, mechanical inspector, General American Transportation Corporation.

(*The report was accepted*)

Private Car Operation Helps Railroads and Shippers

By Leroy Kramer

After explaining how private car companies happened to be developed and what functions they perform, Mr. Kramer closed his address with the following remarks:

Many times it has been claimed that the private car industry is a leech upon the railroads and that the service rendered by the private car companies could be better handled if operated directly by the roads.

Neither of such claims is, in my opinion, based upon a thorough knowledge or understanding of the subject. On the contrary, it is my opinion that the railroads could have saved a huge amount of investment and considerable yearly operating expenses, if they had not individually provided as many cars for themselves as they have in the past. It has been their practice to generally provide enough various types of cars to protect their maximum requirements. It would have been better if they had provided enough to protect their normal requirements but had allowed private car groups strategically situated to supply the excess requirements of certain classes of equipment to certain groups of roads whose seasonal needs did not conflict.

Private Companies Reduce the Need for Surplus Car Equipment

Do not mistake this proposition as suggesting a national pooling of equipment. There are too many diverse types required in different parts of the country and too much inertia in the handling of large groups of equipment, to believe that any car economy would result from a national pool. On the other hand, if a few well-organized, well-run, financially-stable private car companies could supplement the railroad equipment in various districts during various seasons, it would reduce the need for some of the surplus requirements and would better serve the districts which could call upon these companies for their unusual demands.

Much of this type of private car operation, either by districts or by industries, is now undertaken by existing private car companies, some of them having been organized by the railroads themselves, to protect more adequately certain branches of their service. These same types of companies could have added box cars, stock cars, and open type equipment to their fleets and by reason of their closer contacts and knowledge of requirements in the various districts in which they operate, brought about an economy in the use of equipment not now possible.

The above thoughts have been expressed without any idea that they will be adopted but there is much food for thought at this time and in the future, if the railroads are to be brought to the most efficient operating degree. The last two decades have shown conclusively that the railroads no longer have a monopoly. There are other forms of transportation, and while I agree that these forms of transportation have been unduly subsidized by the public, yet I cannot believe that they are to be ignored or eliminated.

Thus it becomes incumbent upon railroad managements as a whole, to consider seriously any and every feature of their operating problems with the view of bringing about the most satisfactory, complete and economical service to their patrons. In this object there is no doubt but what the private car companies can be of tremendous benefit.

Competition Causes Changes in Railroad Transportation Methods

Looking ahead, it is apparent that competing forms of transportation have imposed upon the railroads the necessity for changing their methods. All sorts of ideas have been presented, some of which are sound, but many are desperate attempts to "wish" traffic back on the railroads. This form of wishful thinking cannot accomplish results.

Referring to the high class merchandise freight which has so largely gone to the trucks, a survey was made in Chicago recently to determine whether those shippers now using trucks would go back to the railroads with equal rates and equal time of delivery. Over 200 shippers were contacted and in only one case did the shipper agree that he would return to the railroads on an equal basis. All the others said that either they must get better rates or better service before they will give up the convenience of trucks. Therefore, in this battle of highway transpor-

tation against railways, it is best to face the truth and I advise you car department officers to begin learning about the maintenance of trucks. Some railroads have already engaged in truck transportation and others have stock interest in trucking companies. The latter case is similar to certain railroads having stock interest in private car companies handling railroad cars. The effect is the same. In other words, the railroads are now giving the shipper what he wants and I can foresee a much increased co-ordination between the railways and highway transportation in the future.

The principal object of operating railroads is to make net earnings. If they can make money by the use of buses or trucks in co-ordination with rail service, it is time to use imagination and work out such a plan. For many years the word "transportation" referred almost exclusively to railroad transportation. Today it simply means getting products from one part of the country to another in the cheapest possible way. In the Railway Age of September 30, is the following pertinent statement. "The shipper diverts his goods from railroad to barge or truck—not because barges and trucks are less costly, but because they are less expensive (an important distinction)."

The private car industry today stands ready to give freely of its equipment, organization, engineering talent and imagination to provide better and cheaper ways for shippers to handle their products on the railroads.

Report on Painting

During the past nine years we have witnessed a revolution in passenger-car painting. The advent of air conditioning in 1930 brought a new era of interior design and decoration made possible by the cleanliness resulting from this pressure ventilation. The installation of the first streamlined train in 1934 revolutionized the exterior painting of passenger cars and locomotives. Now this new era in painting is very important to the railroads. It is wielding a tremendous influence in renewing the interest of the American public in railway travel.

Today, the railroads are more than ever endeavoring to have their equipment meet with popular approval. In the past nine years more than 11,500 passenger coaches and Pullman cars have been equipped with air conditioning systems. During the years 1934 and 1938, 85 new streamlined trains were placed in service, and many more have been added this year. Tomorrow, if monetary factors are favorable, it is expected that not only will there be a marked stepping up in the purchase of new equipment of light-weight construction, but there will also be a marked increase in the rehabilitation of existing equipment.

This new era in painting has, of course, increased the work and responsibility of the painter and confronted him with many new problems. Not only has the entire scheme of painting been revolutionized, but the car builders have employed new metal and alloys and other materials that require different treatment and care than do the old ordinary steel and wood surfaces. Most of the roads have adopted their own individual outside color scheme for passenger cars, discarding the Pullman color that predominated for years. Today, we see red cars, gray ones, blue, green, yellow and nearly every color of the rainbow that will attract the eye. Due to high-speed, constant cleaning and the desire to keep the new trains in tip-top condition, means that they will be shopped oftener than is customary with the older cars. And shopping these trains presents problems because in many cases it will be hard to match the new colors or touch them up without creating a spotted leopard effect.

Modern Bright Colors Introduce Problems

The new era of railroad painting has also made the passenger car cleaning problem more important than ever before. Trains with bright colors must be kept constantly spick-and-span or they lose their appeal. The washing of these new cars more frequently than was necessary with the older cars, will, of course, subject them to more abuse because washing tends to mar a car and destroy its finish. The problem therefore will be to keep the cars clean without harming their finish. In this connection, it seems that the old oxalic washing method will have to be discontinued because the streaks and burns caused by that material are more noticeable on the new era cars than on the older cars. Undoubtedly, the manufacturers, painters and chemists will eventually find a harmless substitute for oxalic acid.

That the railroads fully appreciate the importance of properly decorating and painting their equipment is apparent. Few new passenger-carrying cars are turned out today, in the interior design of which competent talent in the interior decorators art is not consulted. However, while consultant designers have been utilized to good purpose, it is questionable whether the railroads are affording their own painters the opportunity to become properly acquainted and educated to meet the changing conditions in the painting field.

While consultant designers are valuable in injecting new ideas, and avoiding violations of good taste and the creation of depressing effects, it is the painter, after all, who does the actual work and who has to maintain the job throughout the years to come.

Many people, including some railroad officials, think of painting as a thing anyone can do—and almost everyone has tried. Real painting is an art, a business of high skill learned only after years of apprenticeship and practice. The reliable painter and decorator makes painting his life work; he knows the fundamentals of his profession, keeps abreast of modern methods and is acquainted with the modern paints and decorative materials which are the proud achievement of American chemistry and mechanical production.

Railway Equipment Painting Supervision Trends Downward

While the status of painters in general throughout the country has tended to rise during the past few years, railway equipment painting seemingly has headed downward, especially on certain railroads. On some railways the painting department has lost its identity, the work rightfully belonging to master painters is being handled, or rather attempts are being made to handle it, by men who don't know even the fundamentals of painting. Master painters who formerly attended meetings and exchanged ideas with other master painters to the benefit of all, are now conspicuous by their absence. While undoubtedly much of this downward trend in the supervision of railway painting is chargeable to the depression, there still remains the thought that some of it is due to the lack of proper understanding on the part of rail-

road executives as to the importance of painting. That railroad painting supervision should be allowed to deteriorate during this new and important era in equipment painting is queer to say the least.

In the matter of ordinary house painting, conditions became so bad that painters license laws were passed during recent years in at least five states. It was found that every Tom, Dick and Harry who owned a brush, wheelbarrow and step ladder was a painter contractor, doing inferior work, using imitation paints, gasoline instead of oil or turpentine, and doing the whole job cheap. Only it happened that home-owners didn't find such jobs very cheap after all. To remedy such conditions, Wisconsin, for example, requires contractors and painters to be licensed, and they must pass an examination before their license is granted. Furthermore, if inferior work is done by a licensed painter, or if poor material is used, a home-owner reports to the state inspector who can revoke the contractor's license, compel him to do the job over, or he gets no pay for the original work. Consider this protection for home-owners and then think of the protection that a railroad will get that belittles and ignores its painting department. You will naturally expect that the painting work on such railroads will be poor and costly.

Twelve Million Dollars Worth of Paint in 1938

The painting bill on railroads runs into large sums of money. The Class I railroads of the country in 1938 purchased over twelve million dollars worth of paint and allied materials. And 1938 was a year of very low purchases. On one railroad it was found that in the shopping of 846 passenger-train cars during the three years 1936 to 1938, painting work took 17 per cent of the total direct labor and material cost of the repairs. This same road in 1938 spent over a quarter of a million dollars in direct labor only to clean its passenger cars at terminals. Isn't it evident from these figures that the painter is responsible for the wise spending of large sums of money? Isn't it apparent that he can be the cause through ignorance of the hidden waste of large sums?

Railroads are constantly being confronted with painting problems that tax the ability and ingenuity both of the painter and the chemist. Recently certain coast-line passenger cars on The Milwaukee Road developed reddish brown streaks in their outside finish, that progressed diagonally from the lower forward corner of the windows and below the felt rail. After considerable study and many tests, the cause of these streaks was determined. The discharge from the alkali blow-off of the locomotive condensed on the sides of the cars particularly along the windows. This dissolved the iron compounds, mostly iron oxalate, which had been formed by oxalic acid seepage around the brass and steel windows from previous washings of the cars. When the accumulation reached a sufficient quantity it was thrown out alongside of the car in streaks. The tests also showed the necessity of using alkali resistant varnish on the exterior of Milwaukee Road cars. The foregoing is a splendid example of the need for close co-operation between the railroad painter and the chemist.

In the foregoing paragraphs I have tried to point out the importance of railroad painting with the hopes that railroad officials will understand and appreciate its importance, and endeavor to build up, rather than tear down, the painting organization on their roads. Needless to say, a well-organized and properly conducted painting department is in a position to save a railroad much money, and enable it to maintain its equipment in the condition the public wants and expects. Many of the traveling public today regard an unsightly passenger car as being unsafe, which is certainly a poor advertisement for railroads which are constantly advertising safety first.

The report was presented by L. B. Jensen, passenger shop superintendent, C. M. St. P. & P.

Discussion

While little time was available for the discussion of this report, the consensus was that, in view of the importance of utilizing the most efficient methods in painting railway equipment and the growing responsibility which rests upon painting supervisors, the association should lend them every encouragement to attend and participate in its annual meetings, until such time as a separate group or organization can be formed to consider exclusively the technical problems of paint materials and their application.

(*The report was ordered printed in the minutes.*)

Shop Operation, Facilities and Tools

In its report for the year 1938 your committee dealt briefly on the subject, Facilities for Freight Car Repair Shops, and in this report we desire to submit, for your consideration, our recommendations covering the facilities and practices relating to the operation of shops handling the machining of wheels and axles.

At the outset your committee wishes to dwell somewhat on facilities which would be considered for the successful and economical handling of this important phase of car maintenance.

The size and location of the shop is naturally dependent on the amount of equipment required to turn out the quantity of wheels and axles needed to supply the requirements. On some railroads, where work of this class is carried on at more than one shop point, it may be found economical to concentrate the work by centering it at a lesser number of shops, preferably one shop.

Where the output of a wheel shop is sufficient to warrant the expenditure, the equipment should consist, aside from the necessary lathes for turning of axles, boring mills and wheel press, of a lathe used exclusively for rolling of journals. Such a machine will be found to result in saving of wear on axle lathes proper which occurs where the rolling of journals is done on the same lathe on which the machining is carried on. Also, it will be found that better workmanship and increased output will be obtained.

Your committee further recommends that where the operation is sufficient to warrant doing so, the dismounting of wheels be confined to a press used exclusively for such an operation as it will save the mounting press from the severe stresses caused by starting a wheel from the axle.

Arrange Machines for Minimum Handling of Wheels and Axles

The arrangement of machines in a wheel shop should be such, as far as possible, as will permit of minimum

amount of handling of wheels and axles. The use of overhead cranes or electric hoists on mono-rails is advocated especially for the handling of axles to and from machines. The storage space for axles should preferably be where an overhead crane or mono-rail can be used to convey the material into shop with the least amount of travel. The rolling of loose wheels to and from machines is practiced in many of the wheel shops and as the men handling such work are usually expert, this method of handling is probably less costly than where other methods are resorted to. Likewise storage space for mounted wheels, both incoming and outgoing, must be provided for and where a dismounting press is used, same can be located so that mounted wheels can be handled from storage through the press, the wheels and axles, being sorted as to scrap or serviceable, and those fit for further service moved to storage spaces for later movement to shop for machining and regrinding.

A lathe for turning journals and axles without removal of wheels is a very useful machine and the average wheel shop should have such facility as it will save the expense of dismounting and remounting of wheels which would otherwise be necessary to permit truing journals of axle. Such a journal-truing lathe also allows for truing of journals when steel wheels are turned, insuring journals being in first-class condition when wheels are returned to service.

Greater use is being made of wheel-grinding machines, and economies can be effected where such machines are available. The grinding of cast iron wheels to eliminate slid-flat spots creates a considerable saving as the wheels would otherwise be scrapped. In the case of steel wheels a considerable saving in service can be made, not only in the grinding of wheels to remove the flat spots, but also in the case of steel wheels in passenger train service and where frequently because of the need for maintaining good riding qualities, it is necessary to remove wheels which have not been worn to the A. A. R. limits. In many cases of this kind, the tread contour can be restored without the necessity of grinding the flange.

The practice of grinding new steel wheels, as well as those which have been turned to restore flange and tread contour, is worthy of serious consideration as it insures such wheels being concentric which is something that is highly important when considering the riding qualities so much desired in passenger-train equipment. Moreover, the grinding of new cast iron wheels is a practice that is being considered more seriously and even being resorted to to some extent. There can be no doubt that concentric wheels will improve the riding of freight cars which is of definite importance especially with the increasingly higher speeds at which freight trains are being operated. There are wheel-grinding machines obtainable today which do all of this work very economically.

In connection with improved facilities for the turning out of wheels, the committee desires to call attention to the fact that some wheel-balancing machines are already in use. The balancing of wheels under motive power equipment of high-speed trains is being carried on to some extent and the time is undoubtedly close at hand when it will be considered equally important to balance wheels for service under passenger-train cars.

Study Shows Many Wheel Shops Should Do Better Work

In this report your committee desires to call attention to the need for improving wheel shop practices, especially with regard to insuring better workmanship in the turning of axles, boring of wheels and mounting of same. If the procedure as outlined in the A. A. R. Wheel and Axle Manual is conscientiously followed, we can be sure of the work being performed satisfactorily. However, your committee has information covering a summary of conditions found within the last year at 76 various shops selected at random in which wheels and axles are machined and mounted, and out of all that number, 27 shops were classed as carrying out good practices and performing good workmanship; 13 of the shops were classed as doing fair work; 36 of the shops were classed as doing work which was in need of considerable improvement. Your committee does not have the information as to ownership of the shops covered by the report, but we have every reason to feel that the information was based on conditions as they were found. Without going into considerable detail it is thought that the members of the association would be interested in some of the extreme conditions found in the investigation, for instance:

Wheels bored ⅜ in. eccentric.
Wheels bored ⅛ in. diagonal.
Wheels bored .008 in. out of round.
Wheels bored .018 in. tapered.
Wheels fitted to axles where .027 in. smaller than the wheel seats.
Finish boring wheels to fit an axle with one cut through the bore.
Wheels finish bored by hand feed.
Boring bar .032 in. loose in the housing.
Wheels bored with common round-nose tool and adjusted with a hand hammer.
Wheel seats turned .008 in. out of round.
Wheel seats turned .022 in. tapered.
Journals being rolled that were not turned.
Mounting gage 21 years old.
Mounting gage ¼ in. out of gage.
A difference of 20 tons pressure between the recording gage and the indicating gage (both on the same press).
Recording gage 50 tons light. (This gage not calibrated in 12 years.)
Recording gage charts with markings ¼ in. wide.
Recording gage charts with wheel fits shown to be 2 in. long.
Pressing two wheels on one axle with one pressing.
Using $^{3}/_{16}$ in. shims in boring mill jaws.
Mating wheels by calipering the treads instead of taping them.
Mounting wheels ⅝ in. out of gage.
Wheel press with a 14-in. ram and a recording gage for a press with a 9-in. ram (both on the same press).
Shops equipped with micrometers and the machine operators unable to use them.

It is obvious to your committee, as it should be to everyone having to do with the machining and mounting of wheels and axles, that discrepancies in practices and workmanship can creep in unless proper inspection and constant supervision is maintained. From the very nature of the inaccuracies referred to in the foregoing, it is quite evident that the maintenance of the lathes, boring mills and presses should be given careful consideration, and that such machines be inspected and checked frequently, especially where the finished work is found to be inaccurate.

The report was signed by Chairman J. A. Deppe, superintendent car department, C. M. St. P. & P.; J. H. Gimpel, assistant superintendent car department, Wabash; M. F. Covert, general superintendent equipment, General American Transportation Corporation; H. S. Keppelman, superintendent car department, Reading; P. B. Rogers, car shop superintendent, A. T. & S. F.; and P. F. Spangler, assistant superintendent motive power, St. L.-S. F.

Discussion

J. M. Brophy, Illinois Central, said, and this opinion was confirmed by other members, that desired accuracy in wheel and axle work cannot be expected without keeping wheel shop machinery in excellent condition and that the individual machines should be checked by competent millwrights or machinists at periodical intervals, preferably not less frequent than once a month.

C. P. Ripley, representing the Technical Board, Wrought Steel Wheel Industry, said that the report is in line with the recommendations of the A. A. R., Mechanical Division Wheel Committee, and there is a gold mine for railroad men in checking the cost figures

for wheel service and making sure that potential service life is being secured.

With regard to the use of one wheel press exclusively for dismounting, Mr. Ripley said that, when this is not available, arrangements should be made to cut out the gage easily when pressing off wheels. Mr. Ripley said that turning lathes are the most important machines in the shop and that the men who operate them can save or lose a lot of money. He urged that lathe operators not be condemned too quickly for work which is not up to the desired standards, for in many cases they do not have the type of machine necessary to give these results.

Wheels must be truly round and mated. One precaution which Mr. Ripley said must be guarded against is the possibility of eccentric wheels due to excessive pressure of the driving dogs which cause the plates or axle to bend slightly. He said that one way to remedy this difficulty is to release the dog pressure slightly for the finishing cut, but grinding is a still better answer to the problem.

Mr. Ripley called attention to the need for a combination wheel lathe with accurate, heavy-duty grinding wheel attachments on the back which will permit turning and finish grinding a pair of wheels on one pair of centers without changing them from one machine to another. He said that wheels should preferably be mated within .005 in. to save flange wear; that the usual method of measuring with a wheel tape is not sufficiently accurate; that the best measuring tool is a micrometer caliper designed to contact the wheel flange in measuring.

One member called attention to the need for more accurate spacing of wheels on axles, since wide spacing on a tight track tends to produce broken flanges. Another member pointed to the necessity for a rapid, accurate wheel press gage so that mounting pressures will be definitely known.

E. G. Bishop, I. C., suggested that the association conduct an investigation so as to develop some definite information regarding the desirability of grinding car journals instead of rolling them, which is the present general practice.

In response to a question, J. A. Deppe, C. M. St. P. & P., said that when a single wheel shop does the work for an entire system, it should preferably be located at the center of use rather than at the center of system mileage.

(The report was accepted and ordered printed.)

Freight Car Inspection and Preparation for Commodity Loading

The relatively small number of freight cars built new, rebuilt or completely reconditioned during the past year and the none too bright an outlook for the future makes the subject of freight car inspection and preparation for commodity loading even more important than heretofore, and if we expect to hold for our respective roads the business they now have and attract new business, we must continue to improve our practices and provide our customers with better service by furnishing them with cars that are clean and in proper physical condition to carry their products to destination without loss or damage.

In our report last year, we suggested that inspection and carding of cars for commodity loading should be done at main terminals or points where repair forces and facilities for cleaning and making necessary repairs were available. This recommendation is renewed and should be followed to the fullest extent consistent with operating conditions. This does not mean that agents and other employees at outlying points should not inspect cars for commodity loading that are available at their respective points. Thorough inspection and intelligent carding by qualified car inspectors at points where cleaning facilities and repair forces are available will, however, result in fewer cars being selected by agents that are not in proper condition for loading.

Our report as submitted a year ago outlined minimum requirements as to cleanliness and physical condition of cars for loading the following commodities: news print paper; flour, sugar and other food products that do not require refrigeration; furniture, doors, dressed lumber, etc.; bulk grain; merchandise and similar commodities; rough freight, and obviously this report referred primarily to box and automobile cars that are ordinarily used for loading these commodities. During the past year there have been no particular changes in requirements as to cleanliness and physical condition of box and automobile cars for loading such commodities.

Compliance with minimum requirements outlined in the report of this committee a year ago will further reduce loss and damage claims that result from loading box and automobile cars that are not in proper condition.

The following is submitted as being minimum requirements covering inspection and preparation of refrigerator cars that are to be used for loading perishable commodities:

Car must be in general good condition for service as to trucks, sills, couplers and draft gears, safety appliances and other running gear parts.

The top of the car must be examined to develop if the roof is in good order and that all hatch covers, plugs and hatch frames are in suitable condition or can be properly repaired before car is reported suitable for initial icing or loading. Ceiling must be inspected for openings or the appearance of a leaky roof. If mold on the ceiling indicates the roof has been leaky, a further inspection of the roof must be made to develop if recent roof repairs have been made correcting this defect. All evidence of mold must be removed.

Floor racks must be inspected and raised, floors examined, and existing defects repaired. The floor pans must next be inspected and any leaks found in the pan or around the trap must be sealed. Car must not be reported suitable for refrigeration loading unless pan leaks can be stopped. All traps must be equipped with caps, cups, or some device that will insure a water seal that will prevent the air from the outside entering car when iced. All cinders, dirt, or any other substance must be removed from floor pans and traps and all drains *must* be fully open—this must be determined by passing a test stick entirely through drain pipes.

Detailed Attention to Refrigerator Cars

After cars have been inspected as indicated above and it is determined they can be conditioned for loading, the floor racks and the car floor must be thoroughly swept, and washed, if necessary; pans, traps and drain pipes thoroughly cleaned; side doors must be inspected; defective door padding must be replaced and sufficient door padding added if necessary to make doors air and light tight when closed. Hatch plug padding must be examined and renewed if defective, or necessary padding added

to effect an air tight fit all around. An inspection must be made from the inside of the bunker to determine that hatch plugs fit properly and that no light shows around the edges of any of them and sufficient hatch plug padding must be added, if necessary, to make a light-tight fit. Side doors and door headers must be inspected from inside cars with the doors closed and latched and, if any light penetrates in the car around doors, sufficient padding must be added to exclude all light when doors are closed. Door header openings must be plugged with hairfelt or a suitable substitute. Loose siding, roofing, inside lining, ceiling and fascia must be renailed; protruding nails must be removed; missing sub-floor replaced; loose or missing floor rack boards renailed or replaced; loose bulkheads secured or braced; loose galvanized iron tank lining or tank screens replaced and secured; and all paper, strips, and other obstructions, removed from all bulkhead screens or openings. All floor racks must be properly secured. Door rods and sockets at top and bottom of door must be in good repair to assure doors fitting tightly. Roof ventilating attachments must be examined and made operative. It is necessary that roof ventilating attachments, including hatch covers, seal pins and chains, hatch cover levers, hatch cover lock lever guides and hatch cover lever anchors are intact and operative. If any of these parts are defective or missing they must be renewed or repaired before car is reported as suitable for loading.

No car must be reported as suitable for loading in which offensive odors are present, or if the floor, sidewalls, or bulkheads have been contaminated by or contain any salt, oil, grease, fats, or any other foreign substance. Cars containing a small amount of salt, oil, grease or fat can usually be made suitable by washing their interior; this should be thoroughly done and all salt and grease entirely removed, as a very small quantity of salt or grease will seriously damage certain commodities by contact. Floor racks should first be thoroughly scrubbed with a broom soaked in soapy water, the racks should then be raised and the floor scrubbed in the same manner. After the foreign matter has been washed out of the car the racks and floors should be rinsed with clear water.

The following formula is one of the best for washing cars when odors are not present: 1 gal. water (preferably hot); 2 lb. soda ash; ¾ lb. hydrated lime.

The above solution to be stirred thoroughly before using. If the above ingredients are not available, water suitably strengthened with soap powder, washing powder, concentrated lye or potash can be substituted.

After car has been washed the hatch plugs must be dropped into bunkers and hatch covers set in ventilating position, allowing a current of air to flow through the car through the hatchway. If possible, cars should be ventilated in this manner in motion when traveling from the conditioning track to the icing station or to a loading station. Side doors should remain open while washed cars remain on cleaning track permitting them to dry out thoroughly. One treatment as outlined above will usually correct the condition of a car previously loaded with salt meat, lard, oil, fruits or vegetables other than onions or cabbage.

Removing Persistent Odors

Persistent offensive odors frequently are present in cars previously loaded with onions or cabbage if a portion of the contents are allowed to remain and decay in the car; also cars loaded with cheese, shrimp, oysters or fish are at times very hard to restore. Frequently several washings and fumigations are necessary to cleanse and purify such cars. The following solution has proven very good in such cases: 1 gal. water; 1½ lb. soda ash; ½ lb. bleaching powder (chlorinated lime).

The bleaching powder must be stirred up in just sufficient water to make a smooth paste without lumps. Then reduce the paste in the full amount of water before adding the soda ash. The full solution should be stirred before using.

When fumigation is necessary, before it is started, all hatch plugs must be placed tight in the hatch-ways and while fumigation is in progress side doors must be closed tight in order to retain all fumes possible within the car. Cars should be closed three or four hours after fumigating fires are started.

In mild cases the burning of two railroad fuses inside car will restore them.

Frequently burning two ½-lb. sulphur candles (one in each end of car) will correct the condition. At times it is necessary to burn two additional ½-lb. sulphur candles if the last fumigation does not suffice.

A more effective method than either of the above is to saturate one pound of waste or burlap in one quart of pure turpentine and add one pound powdered sulphur, placing this mixture in a bucket or some vessel that will prevent car from catching fire. Ignite the turpentine, waste and sulphur, allowing the fumes to remain in the car three or four hours before opening it up.

Another good method of fumigation is to burn two pounds lump sulphur one pound lump Sal-ammoniac in a tinner's fire pot or similar vessel with enough charcoal or kindling to completely consume the sulphur and Sal-ammoniac. This will correct cases that cannot be corrected with sulphur candles or turpentine.

Another effective method of fumigating cars is to burn two formaldehyde candles of the kind used in disinfecting sick rooms. These can be secured at most drug stores.

Great care must always be taken to prevent fire when fumigating cars; when burning charcoal or turpentine a large sheet of tin or other fireproof material must be placed on the car floor under the fire. Formaldehyde candles have receptacles that must be filled with water.

Ventilation and Heater Service-Safety

When conditioning cars for ventilation service, they must receive the same inspection and repair attention as cars to be used for refrigeration service and, in addition thereto, all ice must be removed from ice bunkers.

Instructions covering the conditioning of cars for Ventilation Service will apply to the preparation of cars for Heater Service and Carriers Protective Service, with the addition of the following:

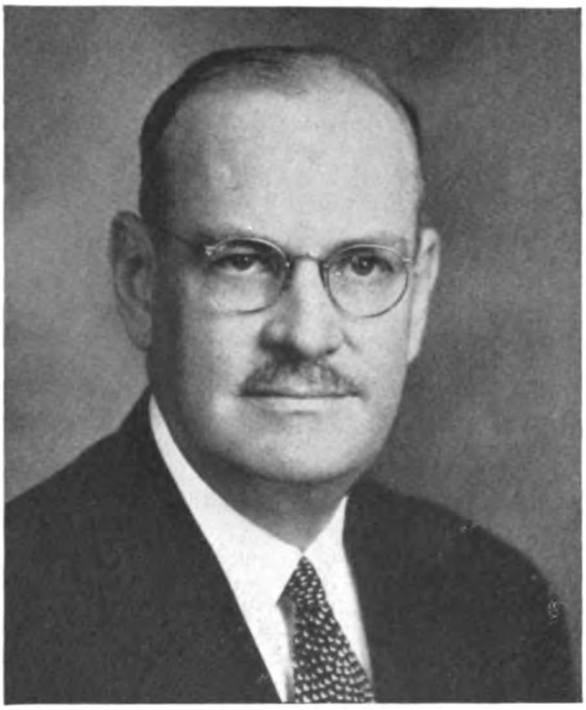
Kraft paper or equal, must be applied the full width of car on the loading space side of the bulkhead wall on cars equipped with Bohn, open, or slatted bulkheads, leaving openings for air circulation 15 inches wide from the floor upward and 15 inches wide from the ceiling downward.

Varying methods of papering, racking and placing heaters in cars are in effect in different shipping sections for various lading, during different seasons, and this work must be done to suit existing local conditions as requested by operating department representative in charge of the district or loading station.

Heated-car warning cards must be applied to door on each side of every car artificially heated and must be removed when heaters are taken out.

When cars are equipped with heaters using either charcoal or charkets, *all persons are warned* against remaining in such cars *with doors and hatches closed. Doors or hatches must be* left open for a few minutes before entering.

(*Continued on page 485*)



J. R. Jackson
President

Speed—Economy—Use—Themes at

Locomotive Supervisors' Meeting

Among the subjects discussed were braking of high-speed freight and passenger trains, locomotive utilization and locomotive economy devices—Many aspects of fuel economy considered in committee reports

DEVELOPMENTS in the braking of high-speed trains, both freight and passenger, were considered at the third annual meeting of the Railway Fuel and Traveling Engineers' Association held at the Hotel Sherman, Chicago, October 17, 18 and 19, along with the problems of fuel conservation. George J. Leahy, Republic Coal & Coke Company, in an address, stressed the partnership of the railways and coal-mining industry and pointed out that revenue from coal traffic of the Class I railways, is fifteen times as great as the oil revenue and questioned the business sense of the extensive use of the Diesel locomotive. Others who addressed the convention were Lee Robinson, superintendent equipment, Illinois Central; and W. A. Hurley, assistant general superintendent, N.

G. M. Boh
Vice-President

W. H. Davies
Vice-President

Y. N. H. & H.; D. S. Ellis, chief mechanical officer, C. & O., and Roy V. Wright, editor *Railway Mechanical Engineer,* were also called upon for brief talks.

Mr. Robinson dealt with the relationship between the maintenance and operation of locomotives and stressed the need for an outlook beyond departmental walls by all supervisors under present conditions. Mr. Hurley, who presented the operating officers' view of fuel economy, stressed the importance of education of employees to adapt them to the changing conditions which they must face during the coming years. Mr. Ellis stressed the need of coordination of the work of all departments. "Don't be prejudiced or too proud to recognize the claims of the other fellow," he said. He also emphasized the need of all having to do with the maintenance or operation of locomotives to know their power and to take measures to have it properly assigned. Mr. Wright called attention to the slowness with which men come to understand each other and learn to cooperate and the apparent reluctance with which industry in general has recognized the importance of the human element as a factor alongside materials and machinery in production. This, he said, is at the bottom of a whole group of problems in the railroad business and expressed the hope that the association would give the human element a large place in its program.

John R. Jackson, engineer tests, Missouri Pacific, president of the association, in opening its first session, reminded the members of the joint session of the four associations, addressed by L. W. Baldwin, chief executive officer, Missouri Pacific, which had preceded the separate meetings of the four associations and recommended that such a joint session become an annual feature of the concurrent meetings of the coordinated associations and that, beginning with next year, the arrangements for this session be handled by a joint committee of the groups represented.

The New Officers

Elected to serve for the coming year were the following officers: President, G. M. Boh, district road foreman of engines, Erie; vice-presidents, W. H. Davies, superintendent air brakes, Wabash; L. E. Dix, fuel supervisor, Texas & Pacific; and A. A. Raymond, superintendent fuel and locomotive performance, New York Central. The following were elected to serve on the Executive Committee for two years; J. A. Burke, supervisor air brakes, Atchison, Topeka & Santa Fe; E. E. Ramey, fuel engineer, Baltimore & Ohio; W. C. Shove, general road foreman of engines, New York, New Haven & Hartford, and W. R. Sugg, superintendent fuel conservation, Missouri Pacific. A. G. Hoppe, assistant mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific, and R. S. Twogood, fuel engineer, Southern Pacific, were elected to the Executive Committee.

Summaries or abstracts of the addresses, papers and reports presented during the meetings follow. In addition to those here printed, a report by the Steam Turbine and Condensing Locomotive Committee was submitted by L. P. Michael, chief mechanical officer, Chicago & North Western. This report will appear in a later issue. J. B. Crawford, fuel engineer, C. B. & Q., presented a report on Fuel Wastes and Losses in the form of a list of items meriting attention.

The Partnership of Coal Mines and Railroads

By George G. Leahy

Republic Coal & Coke Company

George G. Leahy, who spoke as a representative of the National Coal Association, emphasized the fact that the interests of the railroads in the coal industry are closely related and that the two industries are largely dependent one on the other. He cited the prosperity of the coal-carrying roads and the lack of prosperity of the roads which carry a relatively small volume of coal. He also made a comparison of the salesmanship of each of the industries to the other, from which he concluded that the railroads had been the better salesman. In 1938, for instance, the average price at the mine of railway coal was $1.92, while the average revenue received by the railway per ton of bituminous coal hauled was $2.27. Furthermore, he pointed out that the railroads sold three times as many of their units to the coal industry as the coal industry sold to the railroads. Examining the trends in the prices charged by the two industries, he found that the price of railroad coal per ton, including transportation and handling, was $3.94 in 1922, while 16 years later, in 1938, it had dropped to $2.50, a reduction of 37 per cent. The railroad revenue per ton of bituminous coal had dropped during the same period from $2.36 to $2.27, a reduction of but 3.6 per cent.

He then showed how the railroads and the bituminous

A. A. Raymond
Vice-President

T. Duff Smith
Secretary-Treasurer

coal industry had shared in effecting a marked reduction in railway fuel costs—the railroads, by improvements in locomotives and better supervision of fuel consumption; the mines, by improvements in the quality of the fuel on the car and by reductions in price. In 1921, 162 lb. of coal were consumed per 1,000 gross ton-miles and the average cost of fuel was $4.10. In 1938, fuel consumption had dropped to 115 lb. per 1,000 gross ton-miles and the price per ton to $2.50. These two factors resulted in a drop in cost per 1,000 gross ton-miles from 33.2 cents in 1921 to 14.37 cents in 1938. The reduction in fuel consumption was such that the coal actually consumed in 1938 was 21½ million tons less than would have been consumed to move the same trains in 1921. The saving in money at the 1921 price was 88 million dollars and, at the 1938 price, 55 million dollars.

A Coal Man's View of the Diesel

Continuing, Mr. Leahy spoke in part as follows:

"Let me refer to the use of a new medium of motive power by the railroad partner which is disturbing his coal partner; that is, the Diesel engine.

"Perhaps the Diesel has some advantages over the steam locomotive, and undoubtedly the steamer has some advantages over the Diesel and so they may be considered competitive in their fields. But the railroads must have revenue freight before they can purchase or utilize either the steamer or the Diesel, and there is no competition as between the amount of freight revenue provided by the coal industry which furnishes fuel to the steamer, and that provided by the oil industry which furnishes fuel to the Diesel.

"The railroads received about 40 millions of dollars annually from the transportation of fuel oil, and about 600 million dollars annually from the transportation of bituminous coal. There may possibly be a few individual roads who receive more revenue from the transportation of oil than they do from coal, and if so, they should be commended for exploiting and extolling its merits. But for the Class I railroads as a whole, the coal revenue is fifteen times as great as the oil revenue, and it would appear not only commendable but just plain good business sense for them to exploit and extol the use of coal.

"Coal is returning very rapidly to favor for house-heating in connection with the small stoker. Every increase in the use of coal means additional revenue for the railroads, whereas whenever the use of oil grows to large proportions in any area, the oil companies construct a pipe line and keep their transportation charges within their family. Sometimes a railroad provides a portion of its right of way for the pipe line route—but, of course, we must not overlook the fact that by so doing they usually receive the haul on the pipe that deprives them permanently of their oil revenue. Any assistance which the railroads may give to extending the use of coal will be in the secure thought that the traffic will not be diverted to a pipe line after it has been developed.

"We have seen that the railroads have put it all over the coal man in the reciprocal purchase and sale of their respective commodities, and now we find that the railroads are pikers and second-rate salesmen themselves when compared to the oil men. The year 1938 is typical of preceding years. In that year the railroads received from the oil men revenue for transportation of 37 million dollars, but they paid out to the oil men for fuel oil and gasoline 57 million dollars. Contrast that with coal for the same year when the railroads received from the coal men for transportation 511 millions of dollars, and paid out to the coal men for coal 174 millions."

Locomotive Maintenance and Operation

By Lee Robinson

Superintendent Equipment, Illinois Central

Lee Robinson, superintendent equipment, Illinois Central, in an address on Maintenance and Operation of Parts and Appliances which have to do with good combustion, emphasized the need for close co-operation between those having to do with operation and those charged with the responsibility for maintenance; indeed, between all departments. The time has passed, he said, when railroad men can afford to confine their interests to narrow departmental compartments; they must work together for the best interest of the railroad as a whole.

He pointed out the splendid record which has been made since 1920—an increase in freight-train speed of 53 per cent; in gross train load, of 29 per cent; in gross ton-miles per train-hour, of 96 per cent; in gross ton-miles per active locomotive, of 50 per cent, with a decrease in coal consumption per locomotive-mile of 14 per cent. This record, he said, is not enough because, with other forms of transportation taking business from the railroads, government bodies and other organized interests pressing for lower rates on the one hand and increasing costs of labor and materials on the other, the only opportunity to maintain a reasonable margin of profit is to reduce the cost of operation. He also warned that the demand for more speed, both in freight and passenger service, has increased train-operating costs and created avenues for wasteful practice which will get out of bounds if not closely watched.

Such are the problems of today. In speaking of the outlook for the near future, Mr. Robinson continued in part as follows: "Has the conventional steam locomotive reached its ultimate development to meet economically the demands placed upon it? Can a reciprocating type of engine be built for higher speeds than we are now averaging without creating undue and damaging stresses both in the engine itself and the track structure? If steam is continued as the prime mover, will the unit take on some other form of design and appearance than the locomotive so familiar to all of us?

New Forms of Motive Power

"We now have the Diesel locomotive, which you will have to agree has developed very rapidly in the past five years. Naturally, at the outset the first cost was almost prohibitive, except for experimental purposes, but with the increasing development and use of such units, which permits building them on a production basis, the cost has gradually decreased. This cost will, no doubt, continue to be reduced, as increasing numbers are built and placed in service.

"When you consider the greatly increased distances this type of motive power can run without terminal servicing, thereby reducing the total number of units required for a complete trip, when you can eliminate a great number of auxiliary facilities such as coaling stations, water stations, cinder pits, roundhouses and turntables, then the first cost does not appear such a large

factor, and give this type of power a distinct advantage over the present steam locomotive.

"Also we have the experimental or development unit consisting of a high-pressure flash boiler with high-speed steam turbines operating condensing, geared to generators furnishing current to the traction motors for propulsion, which I think is the first challenge that steam construction in a different form than the conventional locomotive has made to the Diesel locomotive.

"Other developments in the form of more efficient transmission of power from the prime mover to the rail are becoming more and more in evidence. Now, do not get the impression that I think the steam locomotive, our old friend, is going to pass out of the picture at once, because we will have it with us for a long time, but it is going to have some lively competition."

Locomotive Design Factors to be Avoided

By F. P. Roesch

Vice-President, Standard Stoker Company

In his paper F. P. Roesch, vice-president, Standard Stoker Company, dwelt on certain features of the combustion equipment of the steam locomotive which are susceptible of improvement. He stressed the importance of adequate air openings into the ash pan to prevent the formation of a vacuum in the pan. He cited a case in which the correction of such a condition recently permitted an increase of ½ in. in the nozzle diameter of several locomotives, effecting a substantial saving in fuel and greatly increasing the efficiency of the locomotives.

In discussing the front end he referred to University of Illinois Bulletins Nos. 256—A Study of the Locomotive Front End, Including Tests of a Front-End Model, and 274—A Supplementary Study of the Locomotive Front End by Means of Tests on a Front-End Model—issued, respectively, on May 30, 1933, and May 21, 1935, as a source of explanation of the function of the front end in producing draft.

With respect to the Master Mechanics' front end with which a large number of locomotives are equipped, he suggested that the recommendations of the Committee on the Revision of the Master Mechanics' front-end arrangement, submitted to the Mechanical Division of the A. A. R. in 1936, be followed. In this connection he pointed out the necessity for internal streamlining to avoid obstructions to the flow of gases through the front end. The removal from the front end of the exhaust-steam-supply pipes for feedwater heaters and injectors should present no difficulties in new locomotives.

Discussion

One feature of locomotive design which affects fuel economy not mentioned by Mr. Roesch was brought out from the floor. That is the action of heavy air currents from over the cab into the coal space in the tender in high-speed service. The effect is to whip fine coal and, in some cases, coal as large as the nut size out of the tender and to scatter it back over the top of the train.

Fuel Conservation from the Viewpoint of the Superintendent

By W. A. Hurley

Assistant General Superintendent, New York, New Haven & Hartford

The opportunity to save fuel is ever present in the operating department, said W. A. Hurley, assistant general superintendent, the New York, New Haven & Hartford, in his address. He outlined the relations of the various officers on the division to the problem of fuel economy. The skill with which the chief train dispatcher makes up the timetables has a marked effect on the coal pile, and the smoothness with which the dispatchers and yard masters work together in getting cars out of the yard and trains into the yard without delays directly affects fuel economy. He pointed out the importance of care in establishing engine ratings. Either under-rated or overloaded locomotives waste fuel. The happy medium must take account of the need to maintain the service which the patrons expect.

"The train dispatcher," said Mr. Hurley, "being the supervising official with whom all the men on the road come in direct contact practically each day, undoubtedly has the opportunity in the course of his daily work to do more than many other employees to get 100 per cent efficiency, with its resultant savings in fuel and satisfied customers. When this feeling of teamwork is instilled and established on a division, unnecessary stops and delays are eliminated and the pounds of fuel per thousand gross ton miles immediately decrease."

After referring to the opportunities in the handling of locomotives through the engine terminal to prevent waste of fuel, Mr. Hurley came to the engine crews. "It is not always the fault of the enginemen and firemen," he said, "that they are not fully posted on all the refinements of the modern locomotive. Many of these improvements have come along in the last few years, and are somewhat complicated in their construction and handling. All of us are growing older, and some of us do not have the faculty that we did 20 years ago to absorb quickly the knowledge that is necessary and helpful in our every-day work, unless some supervisor sits with us and explains just what it is all about. It has been my experience that a 30-minute talk with a person who is fully qualified on his subject is worth more than two hours' time in trying to fathom out a book of instructions.

"An engineman arriving at the enginehouse after completion of his day's run usually has his mind filled with items which he intends to enter in the work book. Some are necessary, while others may be partly imagination. Whether or not these items are properly reported in a manner that enables the foreman or inspector to know just where to look for the trouble and whether or not to order the pit foreman to dump the engine, depends to a large extent on just what kind of a road foreman or fuel supervisor is in charge of the territory over which this engineer operates. If he has never been properly in-

structed on how to report work in the right way, we may expect such items as these on the work book: 'Engine blows.' 'Engine pounding her head off.' 'Engine don't steam.' 'Can't keep water in boiler.' 'Engine won't run.' 'Steam leaks around front end; can't see signals.' On the other hand, if the crew has been properly instructed by the road foreman or fuel supervisor, we may expect reports like the following: 'Engine blowing in right cylinder; renew cylinder packing.' 'Left main rod pounding; reduce back-end brass.' 'Right main crown brass worn.' 'Engine not steaming properly due to load of fine coal; not necessary to dump.' 'Engine not steaming; flues plugged.' 'Two bricks missing from arch, left side; clean out openings in grates.' 'Injectors not working properly; clean out tank and strainers in tank hose.' (This last item would be given to the ash pit foreman by the engineman with instructions not to fill the tank with water until this work had been completed.) 'Pins in valve motion, right and left sides, worn.' 'Clean out exhaust nozzle.' 'Repack left piston.' 'Staybolt leaking under lagging about center of boiler, right side.'

"If these two engineers happened to be on opposite sides of the same run, a glance at the train sheet and at the coal pile on arrival at their terminal would undoubtedly tell another interesting story.

"Education, today more than ever before, has become a necessity. Practically all large and small business concerns are forming educational courses for their employees better to fit them for their positions in these days of keen competition. Why should the railroad man be different from the employee of any large selling organization? The railroads sell transportation, and transportation only. Just how well we succeed in the next few years depends on how well we educate our employees."

Mr. Hurley said that the answer to these conditions for the traveling engineer and fuel supervisor is to ride every locomotive as often as possible. "The enginehouse road foreman or fuel supervisor, like the office trainmaster and the switch-cabin yardmaster, is obsolete," he said. "Get away from the office and the enginehouse detail! Leave a note for the general foreman or call him on the telephone."

New Locomotive Economy Devices

The front-end stoker—A new installation of poppet valves—Movie study of foaming

Feedwater Heaters

No new developments in feedwater heaters have been called to our attention. One manufacturer of feedwater heating equipment, however, is working on the development of a condenser for the purpose of increasing the amount of water reclaimed from the main exhaust channel. It is proposed to provide sufficient condensing surface, to be blown by a fan driven by an exhaust-steam turbine, to condense about 10 per cent of the main engine exhaust. The steam so condensed would be returned to the tank as feedwater and would be in addition to the 12 to 14 per cent returned by the usual feedwater heater making a total of from 22 to 24 per cent of water reclaimed. To date no applications have been made but, however, the details have been worked out and the manufacturer will keep us advised as to future applications.

The extended use of feedwater heaters, particularly in connection with high-pressure boilers, has emphasized the necessity for providing means to insure that cold water be prevented from entering the boiler when the main throttle is shut off. We have previously described a device which uses live steam introduced immediately at the head of the boiler check for this purpose. The Worthington Pump & Machinery Company has added to its system of open feedwater heating, a spray nozzle to be used in connection with a top boiler check which divides the feedwater entering the boiler into finely divided streams. This permits the water to pick up temperature in passing through the steam space and in this way reducing the shock to the boiler.

Locomotive Valves

In the report to the association of 1937, mention was made of a poppet type valve for steam locomotives. The development has proceeded to the point where test application has been made to a Pennsylvania K4s Pacific type locomotive, which left the shop on August 28. No results have yet been made available but it is hoped that by next year's report some detailed information will be obtained for report to the association.

In this connection attention is directed to the report of the Committee on Further Development of the Steam Locomotive of the Association of American Railroads, Circular DV958. This circular calls attention to the necessity for improving the steam distribution in locomotives of high horsepower for high-speed operation. This committee recognizes that possibly the poppet valve is the only arrangement which satisfactorily fits the purpose.

Locomotive Stokers

On one railroad, with the so-called front feed stoker, we find that means have been provided for introducing the coal feed in the front end of the firebox under the arch rather than in the conventional location immediately ahead of the fire door. This means of feeding coal has certain obvious advantages, particularly for such railroads as find it necessary to burn coal with considerable percentages of fines.

In previous reports this committee has frequently called attention to the effect of rather unrelated items on the matter of locomotive fuel economy. At times it has delved into the matter of feedwater heating at terminals and to some extent on feedwater treatment. With the extended use of high-pressure, high-superheat locomotives operating over long runs the matter of the condition of the water in the boiler is becoming of greater and greater importance. This is particularly true in respect to water conditions which bring about foaming in the boiler. Obviously excessive foaming with its attendant reduction and at times total elimination of superheat and all of the evils of the carrying of solid matter into the superheater and thence into the valve chests, cylinders and auxiliaries being operated by superheat steam naturally has a very bad effect on the fuel economy of the locomotive.

The subject of foaming has always been more or less mysterious since it occurs inside of the boiler, being more or less invisible. The Missouri Pacific, in conjunction with the Electro-Chemical Corporation, have lifted the veil and made the interior of a boiler under steam

visible. By the application of glass peep plugs and suitable interior illumination of the boiler it was found possible to take moving pictures of a locomotive actually producing steam at various rates.

The test was conducted in the manner usually followed in standing boiler tests of locomotives. This involves merely the removing of main valves and blocking the piston and wheels in such manner that the engine remains stationary. The desired back pressure and hence draft is produced by opening the throttle until such back pressure is obtained and at the same time suitable disposal is made of the steam produced by the boiler. While this makes an unholy racket, it is still a very convenient means for this purpose. The pictures also show a suggested solution for the control of foaming and the prevention of excessive carry over into the dry pipe and thence into the superheater.

A Look Inside the Boiler

Following the completion of the presentation of the report by Mr. Hoppe, the moving picture showing the action of the water surface inside the boiler taken through windows in the dome was presented. This picture shows rapid forward movement of the water surface and, under foaming conditions, the tendency of the water level to rise, the water below the surface assuming a more or less tenacious spongy consistency. The interpretation of the observations which have been made in this study is that water is carried over into the dry pipe by the whipping action of the steam, which results from the reduction in the area through which the steam must pass over the top of the liquid when the surface rises in the manner indicated. The reduction in steam-passage area over the top of the water increases the velocity and, therefore, the amount of water picked up. The importance of reducing obstructions to permit free flow of steam above the water surface was pointed out.

The moving pictures also showed the action of a trough installed by the Electro-Chemical Engineering Corporation into which the surface water spills when the level rises under foaming conditions which tend to skim off surface impurities to be blown off from the boiler.

In the discussion of another report, a representative of the Baltimore & Ohio referred to the front-end stoker already mentioned in this report, the development work on which has been done on that road. He said that stokers for 50 locomotives have already been bought for the B. & O. and several for the Alton. This stoker, he said, had been developed primarily to reduce stack losses and that it shows a cinder loss 30 per cent less than other stokers and burns 14 per cent less coal per 1,000 gross ton-miles.

The report was signed by A. G. Hoppe, assistant mechanical engineer, C. M. St. P. & P.

Discussion

Following the showing of the moving pictures, in answer to several questions it was stated that foaming is a function of suspended matter as well as of dissolved matter. Impurities as low as 150 grains per gallon will cause foaming if conditions are right. In other cases, 1,500 grains per gallon will not cause foaming. The need for more consideration of the location of the dome was also stressed. It was suggested that solid water might be picked up even in the absence of foaming if the dome were placed on the first course and the entire volume of steam had to pass over the water for the entire length of the boiler.

Utilization of Locomotives

Proper location of coaling stations or large tenders facilitate long locomotive runs

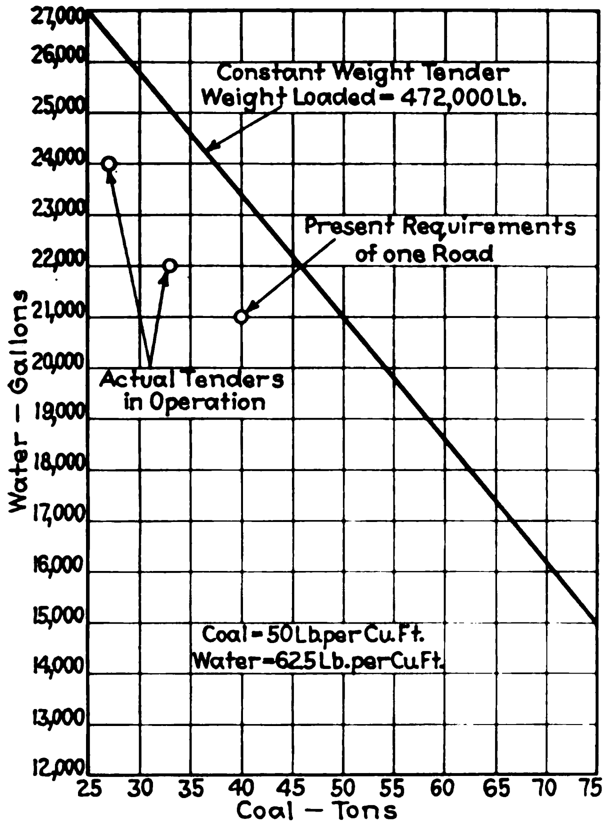
The report discussed the limitations which restricted tender fuel capacity place on long locomotive runs and suggested the methods by which these limitations can be removed. He cited a situation in which a passenger locomotive uses up the greater part of its fuel supply in 350 miles. If the coaling plant is so located that a special stop must be made, a five-minute delay would mean a waste of 1,500 lb. of fuel for the delay and to replace, say, the 727 million foot-pounds of energy lost in stopping the train from 80 miles an hour. Should the schedule be such that the extra stop cannot be permitted, to change the engine will cost 150 lb. getting to the enginehouse, 600 lb. for cleaning and banking the fire, 1,200 lb. for six hours in the house, and 750 lb. to break up the bank and place the locomotive on a train, a total of 2,700 lb. In the latter case two locomotives are required for the run.

In discussing the fueling of switching locomotives the report referred to the many outlying points from some of which the locomotives have to go as far as four or five miles for fuel. Where there are eight or ten locomotives working in the same neighborhood under such conditions, the possibility of installing a small mechanical coaling plant at a cost of about $3,500 was cited. In one such location where 15 locomotives were formerly handling the work 12 locomotives were able to take care of the work after the installation of such a plant. In addition to the reduction in the number of locomotives, 10 tons less fuel was used per day, or 300 tons per month, a saving of $900 per month.

Another solution of the problem of long locomotive runs which the report discussed is the large tender. On the chart are plotted tenders based on two groups that are in actual operation. Taking the total weights of these tenders, a line is drawn through them showing the relative proportion of water or coal that they can carry. The chart shows that with 75 tons of coal the maximum water which can be carried is 15,000 gallons. Similarly, with 25,000 gallons of water the maximum coal capacity will be reduced to about 33 tons.

With the 75-ton tender applied to the situation as cited in the report replacing tenders of 15,000 gallons and 30 tons capacity, which would require two coal stops en route on a 1,000-mile run, the net cost in fuel to haul the larger tender is calculated to be 2,240 lb. This estimate is arrived at by assuming a consumption of 100 lb. of coal for each additional 1,000 gross ton-miles resulting from increased average tender weight, less 3,000 lb. of coal required for two coal stops with the smaller tender.

The report also presented a comparison of the locomotive-miles per active locomotive day for the 13 railroads operating the largest number of locomotive-miles, shown separately for passenger, freight and switching service for the first six months of 1939. The highest mileage in passenger service is 269.7; the lowest, 144.7.



Relation of coal and water on locomotive tenders

The average for the United States is 183.5. The highest mileage is equivalent to an average daily working time of only 6.39 hours. In freight service the highest daily mileage was 123.7 and the lowest, 81.9. The average for the United States is 102.1. The best performance is equivalent to a daily working time of 7.19 hours. In switching service the highest performance is 78 miles, and the lowest 46.2 miles. The average for the United States is 66.6. The 78 miles a day is equivalent to an average daily working time of 13 hours.

The report concludes with a summary of specific suggestions as to how locomotive utilization has been increased by long locomotive runs or more frequent turns. Suggestions affecting other details of practice which have a bearing on locomotive utilization are also discussed.

The committee acknowledged the receipt of valuable information and assistance in the preparation of the material for the report from F. W. Hankins, assistant vice-president-chief motive power, Pennsylvania; G. McCormick, general superintendent motive power, Southern Pacific; J. W. Burnett, general superintendent motive power and machinery, Union Pacific; K. F. Nystrom, mechanical assistant to chief operating officer, C. M. St. P. & P.; G. H. Emerson, chief motive power and equipment, B. & O.; H. H. Urbach, mechanical assistant to executive vice-president, C. B. & Q.; A. R. Ruiter, assistant to chief operating officer, C. R. I. & P., and J. Purcell, assistant to vice-president, A. T. & S. F.

The report was signed by A. A. Raymond (chairman), superintendent fuel and locomotive performance, New York Central; C. M. Darden, superintendent machinery, N. C. & St. L.; G. Hill, superintendent motive power and cars, W. & L. E.; T. Olson, superintendent motive power, C. B. & Q.; N. T. Dempsey, C. R. I. & P., and E. G. Sanders, fuel conservation engineer, A. T. & S. F.

Locomotive Firing Practices—Coal

The committee gives particular attention to a discussion of the causes of honeycombing

In order to fire a locomotive properly a fireman need not necessarily know everything about the theory of combustion; in fact many good firemen do not know a great deal about the theory but a fireman who is familiar with these principles is better qualified to cope with varying conditions in the locomotive firebox.

The problem of fuel conservation involves both mechanical and human factors. The proper functioning of both is essential for efficient results. The mechanical engineering skill of the world is hard at work and there have been wonderful strides made in steam locomotive development during recent years. The human factor involved in railroad operation is at a higher level of efficiency today than ever before. Nevertheless, the human factor, just as the mechanical factor, must continue to advance; therefore, education is still the key to proper and successful locomotive firing practice. Further, the supervisory forces should not only preach proper firing practice but should practice what they preach, and encourage firemen by actual demonstration of proper firing methods whenever possible.

The real secret of success in hand-firing lies in the ability to scatter coal well. After that secret has been mastered no difficulties are experienced in maintaining a light, bright, level fire at all times. The stoker does this when intelligently used.

Honeycombing or slagging of tube sheets is one of the leading causes of low steam pressure and fuel waste on many railroads. This subject apparently was of vital concern as far back as 1914. At the convention of the International Railway Fuel Association in that year, S. W. Parr, Professor of Applied Chemistry, University of Illinois, presented a paper dealing with honeycombing and clinker formation, the opening paragraph of his paper reading as follows:

"As a general proposition, the first step in any attempt to solve a difficulty should doubtless be taken along the line of a search for the underlying cause. If we approach the matter of honeycomb formation on flue sheets from this standpoint we are confronted at once with the fact that the cause must of necessity be more or less obscure owing to the difficulty of obtaining experimental evidence in the vital or formative phase of the matter."

The concluding remarks of his paper were as follows:

"First—the chemical condition, which seems to be most conducive to formation of honeycomb, is the one in which the percentage of iron pyrites is high.

"Second—any conditions in the combustion chamber which, by reason of the time interval for complete oxidation, or temperature stages, or deficiency in oxygen, which would promote the formation for any brief length of time of the iron pyrites in the ferrous sulphide stage, is a condition likely to promote clinkering.

"Third—the physical condition most active in promoting the formation of clinkering of particles in the fire box above the grates is found in the finely divided ma-

terial, which is both high in ash and high in iron pyrites.

"Fourth—at least one practical suggestion is indicated, namely, that so far as is possible the fine stuff be eliminated from the material as fired. Material of this sort may be much more readily handled in fires which are not conducted under such forced conditions as to draft and speed of combustion, it being only necessary to give ample access of oxygen until the time of complete burning out of the sulphur, after which the tendency to fuse is reduced to the minimum."

This subject was also included in Booklet II on Fuel and Related Economies, published by the American Railway Association in April, 1934.

A tabulation of the number of typical ash and sulphur values for different sizes taken from Illinois commercial coal which had been subject to the usual process of handling showed a consistent increase in ash and sulphur with the increase in the fineness of coal.

The importance of this subject is very evident from the fact that the Hudson County Smoke Abatement Association designated a committee to accumulate data for the enlightenment of its members. Their majority report, with the minority report, as written by W. G. Christy, Smoke Abatement Engineer, Department of Smoke Regulations, Hudson County, New Jersey, was published in April, 1938, issue of the *Railway Mechanical Engineer*. This subject was also a topic at the Master Boiler Makers' Association meeting in 1938.

Your committee feels that this subject should now be open for general "practical" discussion, in view of the many locomotives in service that are being worked beyond their predetermined rate; also many railroads are forced to burn inferior grades of coal. It is felt by many that the principal cause is a combination of high draft from whatever cause and certain grades of coal running heavy in fines and high in iron pyrites.

The report was signed by W. C. Shove (chairman), general road foreman of engines, N. Y. N. H. & H.; M. Cavanaugh, fuel supervisor, C. St. P. M. & O.; H. B. Grimshaw, fuel supervisor, Seaboard Air Lines; F. J. Hannon, traveling engineer, E. J. & E.; J. F. Jennings, superintendent equipment, Michigan Central; F. X. Jones, supervisor fuel and locomotive operation, Erie; J. J. Kane, road foreman of engines, Lehigh Valley; J. C. Lewis, road foreman engines, R. F. & P.; H. L. Malette, road foreman of equipment, St. L.-S. F.; G. S. Mikles, fuel supervisor, N. Y. O. & W.; H. Murphy, instructor fuel economy, B. & O.; T. V. Ramsey, road foreman of engines, Wabash; S. M. Roth, road foreman of engines, Western Maryland; H. W. Sefton, supervisor locomotive and fuel performance, C. C. C. & St. L.; W. E. Small, B. & M., and R. A. Stickney, fuel supervisor, Great Northern.

Discussion

It is evident from the discussion that there is little co-relation between many of the conditions associated with the formation of honeycomb and the extent to which honeycomb is actually experienced. In one case of stoker-fired passenger and freight locomotives using the same fuel more trouble was experienced with honeycomb in the freight locomotives than in the passenger locomotives. This was attributed to the fact that the freight locomotive had a combustion chamber only 18 in. long, while the passenger-locomotive combustion chamber extended into the boiler 48 in. The longer path of the gases in the latter case was assumed to provide time for the particles of slag to cool before striking the tube sheet.

The analysis of a sample of flue-sheet clinker from a coal with 13 per cent ash, of which 4 per cent was iron pyrites, was given. It was: silica, 26.5 per cent; iron oxide, 45.2 per cent; aluminum oxide, 13.12 per cent; calcium oxide, 6.79 per cent; combustible, 8.57 per cent.

It was pointed out that honeycomb is produced from many different coals, and that today it forms under one set of conditions and tomorrow under another. In one case cited honeycomb tends to form when the locomotive is working hard and little clinker forms on the grates. When the locomotive is working light, however, the conditions are reversed, clinker forming on the grates and little honeycomb forming on the tube sheet. It was pointed out that with Rosebud coal, which is burned on the Northern Pacific and which has but 0.5 per cent of iron pyrites, honeycomb forms at times. On the locomotives with 182 sq. ft. of grate and 78-in. combustion chamber, however, burning 15 tons of this coal per hour at the peak on 3/8-in. round-hole grates, no difficulty from honeycomb is experienced.

Passenger-Train Braking

Descriptions of graduated-release and short-cycling methods of mountain braking

The elements of the air brake system which lie between the brake cylinder and the rail directly limit the retardation obtained by an application of the brakes. These elements are the rail, the wheel, the brake shoes, and the foundation brake rigging. Recent changes in railroad operating practices have emphasized the important part these elements play in securing rates of retardation.

High Retardation Rates

With trains moving at high speed, unexpected conditions may arise which will necessitate a reduction of speed, or a complete stop with very little, if any warning. It is then that the highest rate of retardation possible is imperative and it is the deciding factor in the safe operation of such vehicles. The stop distance can be roughly determined if the retardation is known, and it is expressed in so many miles per hour per second, indicating the reduction in speed of the train per second. The per cent retardation obtained by action of the brakes fixes the rate of retardation. Actual tests have demonstrated that a rate of retardation in excess of three miles an hour per second is difficult to obtain even with the modern light-weight trains, unless the rail is heavily sanded and the braking power evenly distributed on all wheels in proportion to the wheel load carried.

Even distribution of braking power means that each pair of wheels must be braked to the limit, keeping in mind that if the effective retardation equals the coefficient of adhesion the wheels will slide and lengthen the stop. Car wheels can be braked to the limit, but locomotive wheels cannot with any known equipment, not even on power trucks with Diesel or electric locomotives. This imposes an additional burden on the car-wheel brakes, which must assist to retard the weight of the locomotive in addition to that of the car.

If a stop is to be made from high speed within a

reasonable distance, it is important first to get the brakes applied as quickly as possible; a train moving at 90 miles per hour is covering 132 ft. per second. It is obviously important to set up the highest possible rate of retardation while the train speed is high. All train stop records show that when the speed has been reduced by half, about 80 per cent of the stop distance will be covered.

The ideal brake would, therefore, be one which would develop braking power just under the factor of adhesion through a stop that could be applied within two seconds or less on all cars simultaneously. To date there are two factors which place restrictions on too rapid application; one is passenger comfort, and the other is a tendency to set up extremely high friction values if too much shoe pressure is developed while the shoes are cold. It has been proved impractical to develop over 200 per cent braking ratio in less than three seconds with standard cast-iron brake shoes.

The Disc Type Brake

Recently a new type brake has been developed which uses automotive type brake lining on a two-face disc bolted to the inside hub of each wheel. Because of the more uniform friction values of this lining it has been found possible to apply this brake with full power in nearly half the time it can be applied with cast-iron shoes without danger of sliding the wheels. This type of brake lining has a more uniform coefficient of friction throughout a stop than a cast-iron shoe, which eliminates the necessity of reducing the brake-cylinder pressure as the speed reduces to avoid sliding the wheels. It is also capable of setting up a higher rate of retardation during the early part of the stop, a very valuable feature.

If the wheels are to be braked up to the limit of adhesion when the rail is in good condition it follows that this limit will be exceeded when the wheels find a low rail joint, bad crossing, or a wet spot, in which case the wheels will slide. Therefore, if braking forces are to be employed materially in excess of present conventional brake practices, a device to prevent the wheels from sliding without interfering with safe operation of the train is necessary. The values of coefficient of adhesion have been reported by various experimenters ranging all the way from 8 per cent to 10 per cent without sand on a poor rail, to as high as 40 per cent on a good rail, the average being around 25 per cent.

To reduce the stop distance the method of sanding requires considerable study. Our very best present means of sanding the rails is entirely inadequate for speeds much over 30 miles per hour. Very little sand actually gets under the wheels at the higher speeds owing to sand pipes being too far away from the wheel-rail contact; and owing to the blast of air used to blow out the sand and the wind due to the movement of the train. To sand a rail properly at high speed the sand must be delivered close to the point where the wheel meets the rail and should be delivered in a thin sheet about 1 in. wide. Several manufacturers and railroad men are said to be working on improved methods of sanding or conditioning the rails for stopping high-speed trains.

To further improve the rail condition, there is much to be done in locating steam and water traps as far away from the rail as possible, as well as controlling the dumping of water and other refuse from cars, which at present in some instances is falling on the rail and creating a very bad condition when brakes are being applied.

Assuming that everything possible has been done to insure a good rail condition, the fact still remains that as the speed increases, the adhesion between wheels and rails decreases because of the bouncing of the wheel over the imperfect surface of the rail and because of the momentary unloading of the truck on account of the vertical oscillations of the car.

Graduated Release on Mountain Grades

In handling conventional type of passenger car equipment on mountain grade districts, two general methods of braking are employed. One, known as the graduated release method, in which retaining valves are not used, has proved highly desirable in districts where undulation of the grade and curvature will permit complete release of brakes and recharging of the brake system at sufficiently frequent intervals to prevent depletion of the brake system pressures to a dangerously low point. The cooling of brake shoes and wheels during release periods is of material advantage and the inconvenience of operating retaining valves on head-end equipment is eliminated. This is especially advantageous on trains handling a high percentage of mail, express and baggage cars.

When handling passenger trains on descending grades by the use of the graduated-release method, the brake system must be charged to standard pressure before departure from the summit of the grade. After entering upon the grade and a speed approximately that permissible for the grade has been attained, a service brake application should be made sufficient to control the train at the desired speed. Allow the brake valve to remain on lap position until a change in speed is observed and if the speed continues to increase, make a further brake pipe reduction; if decrease in speed is noted make a partial release of the brakes by moving the brake-valve handle to running position until an increase of three or four pounds brake-pipe pressure is obtained, then return the valve to lap position. Succeeding partial releases may be made by increasing brake-pipe pressure approximately two pounds, using running position. If a reduction in speed is necessary, light additional service applications will accomplish the desired result. Often the desired increase or decrease in speed may be made by simply applying or releasing the locomotive brakes by use of the independent brake valve.

A complete release of the brakes and recharge of the brake system must be made at frequent intervals, taking advantage of curves and changes in grade to avoid excessive increase in speed during the recharging period. Every effort must be made to maintain a uniform speed and if applications and releases are properly timed no difficulty will be experienced in maintaining brake-system pressures and proper speed. Enginemen should try to anticipate necessary changes in speed and not wait until a condition of speed change makes necessary a drastic change in brake-cylinder pressure. If this is done the speed change will soon correspond to the change in cylinder pressure and an erratic speed would be the result. This is detrimental to brake shoes and wheels and should be avoided. An even speed will produce the most uniform wheel heat and secure the most desirable results, as by so doing air pressure will be conserved and smooth train handling will result therefrom.

To avoid damage to driving-wheel tires, the continuous use of the driver brakes should be avoided, except in cases where it becomes necessary to make a considerable reduction in speed or in bringing the train to a stop. The locomotives on many mountain railroads are equipped with a driver-brake release or a three-way cock located in the cab or a retaining valve on the tender which permits release of driver brakes while the tender and truck brakes remain applied.

In approaching stations at which spot stops are necessary such as in approaching water cranes, etc., the brakes should be applied on the train in the usual way by adjusting the slack in the train with light applications and

increasing the applications as necessary to accomplish the slow-down. The brake application should finally be sufficient so that if left applied it would stop the train short of the desired stopping point. Then, when the speed has reduced to approximately 15 or 20 miles per hour, a graduation of the brake-cylinder pressure should be started by moving the brake valve to running position and then back to lap. This procedure should be continued, reducing the brake-cylinder pressure as the speed of the train reduces, planning the stop so that little if any pressure is left in the brake cylinders when the stop is completed.

If error has been made in judgment so that it becomes necessary to reapply the brakes under these conditions before the brake-cylinder pressure has exhausted, the succeeding application should be made very light. If the brakes are entirely released, a five-pound brake-pipe reduction should result in approximately 10 or 12 lb. brake-cylinder pressure. If the brake-cylinder pistons are still out, even though no pressure is shown on a brake-cylinder gage, and a five-pound brake-pipe reduction is made, the brake cylinder pressure will be at least 25 lb. This emphasizes the necessity of care being exercised, when spot stops are being made, in making such applications sufficiently light to guard against harsh slack action.

Short Cycling with the New Retainers

When retainers are used in mountain-grade braking the most successful method is found to be what is known as the short-cycle operation of the brakes. In the short-cycle method of braking, the brakes are applied with sufficient force to control the speed of the train and as soon as practicable are released, allowing the retaining valve to blow down the cylinder pressure gradually between cycles. This method provides for control and at the same time keeps the brake system practically fully charged.

The new A. A. R. standard passenger-car retaining valve, which provides for slow continuous blow down and complete release of brake-cylinder pressure when the retaining valve is in operation, has eliminated many of the former undesirable features of this method of braking on descending grades. A complete release of brake-cylinder pressure can be obtained without placing the handle of retaining valve in direct release position. This feature is very desirable, making possible the operation of trains over lighter undulating grades without changing the position of the retaining-valve handle. This same feature permits a train to be started with brakes completely released after stopping on a descending grade, which contributes to smoother handling and reduces the liability of slid flat wheels. Experience has proved that the brake-shoe and wheel damage on cars equipped with this form of retaining valve has been greatly reduced when operating on heavy grades.

The short-cycle method consists of making frequent brake applications and short holds, restricting the release of brake-cylinder pressure to a pre-determined rate by use of retaining valves, which allows a sufficient time interval for recharging the brake system before any appreciable increase in speed occurs. If brake applications and releases are properly timed, uniform speed can be very easily maintained and smooth handling will result.

The report was signed by J. A. Burke (chairman), supervisor air brakes, A. T. & S. F.; C. H. Rawlings, general air-brake instructor, D. & R. G. W.; Lee Pearson; A. C. Drye; H. I. Tramblie; J. Mattise, general air brake instructor, C. & N. W.; R. F. Thomas, general air-brake inspector, Canadian Pacific; G. H. Highley, and John Kane.

Discussion

The discussion was largely in the form of questions which Mr. Burke answered. In his answers he made it clear that no attempt is made to graduate off the brake on a very long train when it gets down to speeds below 15 or 20 miles an hour. When stops are made with a light reduction remaining on a 15- or 16-car train, Mr. Burke said that he would expect the engineman to add a further brake-pipe reduction following the stop before attempting to release, thus insuring a release of all the brakes. With short trains, however, these precautions are unnecessary. On mountain grades, he said, it is necessary to release the driver brakes. He does not advocate this in ordinary operation, however.

Grates and Ash Pans

The report reviews development of pin-hole grates and advantages of level grates

The report on Grates and Ash Pans reviewed the development of the so-called pin-hole grates with a small percentage air opening, applied horizontally in the firebox, in connection with the burning of low-grade fuels on three western railroads. In the case of the Union Pacific, the report cites a locomotive built with horizontal grates of 70 sq. ft. area and 14 per cent air openings designed to burn a sub-bituminous coal of 8,800 B.t.u., 18 per cent moisture and 8 per cent ash. Older locomotives on this railroad of similar capacity had 45 to 50 sq. ft. of sloping grate with 35 to 45 per cent air openings. On the Northern Pacific the comparison was between locomotives of the same class when converted to burn low-grade fuel by replacing the sloping grate with a grate placed horizontally in the firebox and reducing the air opening from 38 to 42 per cent down to 15 per cent through the small round openings. This change in the locomotives was found to effect an improvement in the burning of the high-grade coals as well as the low-grade coals for which the conversions had been made. This simplified the extending of engine runs by making it possible to burn two or more grades of coal on the same trip.

Another advantage effected by the use of level grates with restricted air openings was the reduction in ash-pan maintenance cost due to the smaller accumulation of burning fuel into the ash pan.

In the matter of fire cleaning, a comparison was made between locomotives with the sloping grates, which could open in only one direction and were difficult to shake, with locomotives equipped with horizontal grates. In the former locomotives the fire bed was 12 in. thick with several clinkers in the grates and 36 min. was required to knock the fire and clean the pan. In the latter locomotive the fire was 5 in. thick with no clinkers and required 11 min. to knock the fire and clean the ash pan. This comparison covered engines running over the same district burning the same kind of coal and handling the same tonnage. The former locomotive, however, burned about four tons more coal than the latter.

Automatic Draft Control

As a result of an inquiry from the floor, B. C. Bertram of the Lehigh Valley described the automatic draft control system which has been developed and is being extensively applied on that railroad. In principle, this system drafts the locomotive to provide adequate draft for light loads and in starting trains, so that the locomotive would be overdrafted when working heavily at high speeds, except that an automatic unloading valve prevents the back pressure from rising about a predetermined maximum. With this arrangement of draft control grates with 40 per cent air opening are employed, burning egg coal. The maximum back pressure is limited to about 5 or 6 lb. The full opening of the unloading valve, which is a commercial vapor-cushioned type that is free from pounding, in effect increases the exhaust outlet from the equivalent of an 8¼-in. nozzle to the equivalent of a 10-in. nozzle. Mr. Bertram said that the draft control eliminated cinder losses.

The report was signed by M. F. Brown, fuel supervisor, Northern Pacific.

Oil-Firing Practice

Closed car heaters help to keep fuel dry - A fuel-oil thermometer needed

The short report in 1938 was in the form of a questionnaire. An attempt will be made to summarize this information and apply it to the actual job of firing an oil-burning locomotive. We must still preface this report, however, with the statement that the variation in grade of fuel oil, methods of handling and heating, methods of firebox, burner and air-opening design materially influence the general statements in this report.

Cracked Fuel in General Use

So nearly 100 per cent of the locomotive fuel oil burned today is cracked that we need not discuss the lighter fuels. In fact, the most of the cracked fuel produced today is cracked beyond the fuel-oil state, then blended back by adding gas, oil or other lighter products. I think that answers Question 1 in last year's report, "Are cracked and heavy fuels now used by all oil-burning roads?"

As to questions 2 and 3, as to whether it is possible to obtain the same quality on all divisions or whether chemical and physical characteristics vary frequently, making it necessary to keep changing instructions: Our better knowledge of the use of cracked fuels has made it possible to instruct in more general terms that will bridge most of the variations in characteristics.

As to Question 4—firing temperatures, 150 deg. F. is not too hot for any of the cracked fuels. Then suppose we start from there and gradually raise the temperature until best results are obtained. A 15-deg. or 20-deg. variation is not serious. The heaviest of the fuels should burn at 180 deg. F., therefore it should not be hard at this time to arrive at a satisfactory average temperature. Now, to help the fireman get over the road, let us turn the engine over to him with the fuel and burning equipment in proper condition.

Keep Fuel Dry

First the fuel: Fuel soaked with water is no more satisfactory for burning than wet fire wood. If you will keep the fuel dry right to the burner, the saving in fuel will pay big dividends on the cost of closed heater equipment. Practically every specification calls for a dry fuel. The first place that water can be added is when heating in the car before unloading. The nice thing to do is to have closed heaters in the cars. Some of us are still too hard up to reach this happy state, and have to find a cheaper method. A portable closed heater coil on a crane over the unloading track is not very expensive. A closely wound coil small enough to drop through the dome is large enough to do considerable heating. If lowered into the car right over the drain pipes, it will be quite effective in warming the fuel sufficiently for satisfactory unloading, even in below-zero weather.

Unloading and service sumps and storage tanks should have closed heaters. Then, with proper supervision and operation of fueling plants, it should be possible to supply the locomotive with a warm, dry fuel. Two per cent is submitted as the maximum permissible moisture to be allowed in the fuel as it reaches the burner. With the above outlined closed-heater equipment, you will find the average fuel sample at the burner to contain less than one per cent moisture.

Now that the tender tank has been filled with a warm, dry fuel, why spoil it with a open tender heater? Complete the job with a closed heater in the tender.

Know the Temperature of the Oil at the Burner

The temperature drop from the tender to the burner is variable. The fuel is burned at and beyond the burner, so the temperature at the burner is an important detail to know. The fuel-oil thermometer is now a recognized instrument on an oil burning locomotive. Realize, however, that at the present time only a small percentage of oil-burning locomotives have been so equipped. Why guess at such an important detail when the fuel cost averages around $100 per trip.

The Fireman's Job

Now let us introduce the fireman and start the trip. The fireman checks the fuel and water tank and other items with which we are familiar. He notes the oil temperature, either by feeling the tank or reading the thermometer. If the oil is not quite up to temperature, he turns on the oil heater so that by the time he is ready to leave the terminal the oil will be at the right temperature. It is important that the blower, atomizer and firing valve be properly regulated during the preparatory time. It is discouraging to a supervisor to note a locomotive standing with too much atomizer, or blower, smoking or gassing. Soot may be forming in flues or on front-end netting. Drumming is hard on brick work.

After starting the blower should be shut off. There is no value in wasting steam through a 1-in. or 1½-in. line. At the beginning of the trip, feel out the atomizer and note the opening of the atomizer valve; that is one-quarter turn, one-half turn, or more. The best way to determine the best atomizer setting is to watch the fire through the peep hole. When the fire is steady, white, and does not tend to come out the fire door, the atomizer is about right. Then look at the stack, and if it is not clear try a slight adjustment one way or the other. For the rest of the trip it should not be difficult to adjust

the atomizer slightly from time to time to meet the varying conditions.

As a rule a heavy atomizer will cause drumming, overheating of firedoor, carbon formation on flash wall account too much fuel in back of fire box and not sufficient air to burn it. Too light an atomizer will permit the forced draft to turn the fuel back, causing too great a proportion of the heat in the front end of the fire box, or when standing permit the fuel to drop, setting fire under the engine or building up carbon on the floor of the furnace. Note the fuel temperature frequently.

Just before starting the trip the boiler pressure should be at the maximum and water perhaps slightly above normal. Then do not try to force the fire and feedwater pump at first. The brickwork and firebox are not thoroughly heated. If there is plenty of water in the boiler, the pump can be worked lightly a mile or two to give the firebox a chance to warm up. An oil-burning locomotive is very sensitive to water-pump operation. Get into the habit of opening or closing the pump throttle a very little at a time. Large changes in pump throttle mean flooding or starving the boiler of water, with resultant excessive fluctuations in steam pressure. Know the road and watch the engineer. Change the firing valve and pump a little at a time to compensate for change in engine throttle or cut-off. Always have plenty of water to be safe, but remember that high water lowers superheat temperature, interferes with valve and cylinder lubrication and increases fuel and water consumption.

At the End of the Trip

If the fireman is doing a good job of firing, he should be the best authority at the end of the trip as to just what work, if any, should be done on the firing equipment. At the end of the trip look in the firebox to see if the fire has been dragging on the floor of the furnace, burning on one side or throwing the fuel too high. The color of firebrick and firebox sheets will tell whether or not the temperatures have been fairly uniform throughout the box. A dull gray color on firebox sheets means the ash of soot, or a high temperature to burn the soot on the sheets. A black color means unburned soot, or a medium temperature. Dried-up or sticky fuel means a low-temperature spot. Be helpful and report these conditions, with your opinions as to firing or steaming. The enginehouse men need your help and you want them to understand, so that the locomotive will be in condition for a good trip next time. Team work counts.

The report is signed by R. S. Twogood, fuel engineer, Southern Pacific.

Present Influence of the AB Freight Brake

A method of controlling slack in high-speed freight service with modified H-6 brake valve

The percentage of AB valves, now in service is not great enough to insure the full benefits being derived from important design features. I have particular reference to the positive application and assurance of release with minimum service reductions, the ability to obtain a prompt emergency application following a substantial service application or a release, and a prompt release following an emergency application. As the proportion of AB valves in trains increases, there will be a proportionate improvement in overall train performance. In connection with this, recent check was made of 50 trains as to the proportion of AB valves, which was found to be 20 per cent.

Keep High Standard of K Triple Maintenance

We will be faced with the necessity for maintaining K equipment in first class operating condition for several years to come; and if these are to be successfully operated in comparatively long trains and associated with AB equipment, our standard of maintenance must not be lowered simply because it is no longer considered a standard for new equipment.

As the train lengths are increased, the rate of brake-pipe pressure change, during an application or release, becomes increasingly slower and few appreciate what the condition of a triple valve must be to respond properly to these slow changes in pressure. Many railroads make repairs at outlying points which do not afford the equipment necessary. It has been found that improper lengths of feed grooves, elongated exhaust ports, distorted piston heads and shanks, filed piston shanks, short graduating stems, and many other similar operations, classed as improper repairs, can be traced, in most cases, to methods used in these outlying districts.

The quality of workmanship in making repairs should not be based on a minimum permissible limit at which valves may be returned to service; but all railroads should follow the example set by a few, and improve their repair standards to a point which will meet the more exacting requirements of modern long train service. The difference in cost of making repairs which are comparable to the air brake manufacturer's standards and those which will just pass test rack requirements is very small in comparison to the many benefits derived.

The Air Brake Manufacturers have spared no expense in building the new AB equipment to standards which will satisfy present and future operating requirements. It is, therefore, our responsibility to see that these standards are maintained in order that the railroads shall obtain its full operating benefits.

As an example, the precision to which the slide-valve faces and seats, also piston bushings were originally finished, is such that only the most modern methods for effecting repairs can re-condition the valve to its original standard.

At the time the AB valve was developed, considerable study was directed to suitable maintenance of operating standards. To determine this quickly and efficiently the AB test rack was developed to ascertain if the valves comply with proper standards of operation and workmanship, and if not, wherein they deviate from such standards. The test sequence is such as to point out a defect in order that proper repairs may be accurately made. The rack is compact, accessible to the operator from one position, and requires a minimum of maintenance. The use of diaphragm cocks, of the cam-lever opening type, and a water column for accurately measuring pressure differentials are but examples of details which make the rack a very accurate means for determining the desired standards.

Due to the extension of time between cleaning periods, more effective means are required for excluding moisture and other foreign substance from the brake pipe in order to insure that feed grooves and other charging ports will

not become unduly restricted. A pump intake filter of high efficiency in intercepting even the finest particles of dust, is an important item in the general air brake system. The benefits derived are not alone confined to the brake system, but the service life and dependability of operation is greatly extended. Efficient means for filtering all air leading to the vital operating parts of the AB valve insures continued lubrication of the packing rings and eliminates the development of high friction.

Of major importance is the problem of properly cooling the compressed air, employed in the brake system. It is important that the air be cooled to as near the surrounding atmospheric temperature as is possible, and yet avoid undesired freezing in the cooling system during extremely cold temperatures. Double pump installations, maintained at high efficiency, are important aids to the elimination of moisture in the brake system.

Brake pipe leakage has always been a very pertinent subject, and the successful handling of long trains only serves to point out the necessity for continued efforts on our part to reduce it to a minimum.

Importance of Time Element in Adjusting Slack

Slack action is the major cause of damage to equipment and lading. While it cannot be entirely eliminated; it can be controlled so as to avoid material damage. The successful handling of freight trains involves a gradual re-adjustment of train slack; and is equally important during the starting and stopping. Train slack cannot be changed quickly and at the same time smoothly. Time element is a very important factor in all forms of brake operation; and its relation to other functions becomes more important as the train lengths are increased.

The slight time advantage gained by the use of release position during initial charging as compared with the use of running position only when employing a modern high capacity feed valve properly installed with minimum piping between main reservoir and feed-valve bracket, and feed-valve bracket and brake-valve bracket is invariably offset by the time required to insure the release of reapplied brakes. Actual tests have demonstrated that brakes which have reapplied back in the train a distance of 20 cars or more cannot be positively released by a flash kick-off without danger of causing more brakes to reapply at the forward end.

Overcharges are positively eliminated by the use of running position only and many railroads have issued instructions to eliminate the use of release position entirely. The use of running position only avoids the direct passage of moisture to the brake pipe, such as will invariably occur should reduced air, at the high relative humidity, be admitted directly to the system during the initial part of train charging or during a release period.

It has been found that the freight train handling instructions as contained in Air Brake Association Book No. 8 can be successfully used, producing the desired results, with but a few exceptions and these perhaps where because of out of ordinary conditions it may be necessary to cover the condition by special instructions.

Controlling Slack with the Brake

When designing the AB valve the transmission rates for both service and emergency functions was materially increased in order to reduce to a minimum the ill effects of damaging slack action. The full benefits of this design feature will become more apparent as the percentage of AB valves in a train increases. With the average of 20 per cent of AB valves per train, however, the advantages of the AB valve features is very noticeable, especially in regard to service application and release of brakes.

Because of this we have instructions, with trains of 75 cars and under, to release whatever brake-pipe reduction there is at the time the brakes are to be released. That is if a 6-, 7- or 8-lb. total brake-pipe reduction is sufficient to accomplish the desired result this reduction is released without the necessity of having a definite total reduction to assure release that heretofore was thought necessary. We are now using the brakes for slack control at all locations that slack action usually occurs without reducing the speed and, of course, we are using the brakes for definite speed reductions as well as stops.

On the Missouri-Kansas-Texas short high-speed trains of 75 cars and under are very difficult to handle. The road characteristics are such—hog backs and curves—that while the effort is being made to operate at high speed the slack action is so severe that it cannot be tolerated. We now use the brakes for slack control. Our freight train handling instructions are, in part:

"A—Considering all factors that enter into safe train handling, it will be necessary to discontinue drifting wherever possible and resort to the use of pulling throttle against brake application. This can be done as per item B. Wherever grade conditions are such that the methods in item B cannot be used and it is necessary to drift this must be done at a lower rate of speed."

To control the train at high speed for safe operation and to control the slack action at such location where it will run hard and where no definite speed reduction is involved, the following operations are used:

"B—Use a pulling throttle. Have the slack all out. Make the first reduction 6 lb. Keep the locomotive brake from applying through the entire operation, and while the brake-pipe service exhaust is discharging open the throttle three or four notches in order to have the locomotive pulling harder while the brakes are applying. Use this brake application until the results have been accomplished. When ready to release, place the brake-valve handle in running position, leaving it there. In case the speed increases, make another light reduction."

At locations where a definite speed reduction is to be made the following operations are made:

"C—Use a pulling throttle having the slack all out. Make the first reduction of 6 lb. Keep the locomotive brake from applying throughout the entire operation, and while the brake pipe service exhaust is discharging open the throttle three or four notches in order to have the locomotive pulling harder while the brakes are applying. After the service exhaust ends, gradually reduce the throttle to a light pulling throttle. If necessary, make a few additional light reductions 2 lb. at a time. When ready to release the brakes, place the brake valve in running position; at the same time reduce to a light drifting throttle."

When making stops we use the following operations:

"D—Use a pulling throttle. Have the slack all out. Make the first reduction of 6 lb. Keep the locomotive brake from applying at this time, and while the brake-pipe service exhaust is discharging open the throttle three or four notches in order to have the locomotive pulling harder while the brakes are applying. After the brake-valve exhaust ends, reduce to a moderate pulling throttle, easing off if necessary to maintain this. If necessary, make additional light reductions of 2 lb. Then, when within 8 or 10 car lengths of being stopped, use sand continuously. When within 40 ft. of being stopped, make a reduction of 6 to 8 lb., allowing the locomotive brake to apply and shut the throttle, having the brake-valve exhaust open when the train stops."

The three above operations described are used with all make-up of trains except with the heavy loads behind. With such train make-up we reduce to a light drifting throttle before the brake application as per item A.

We believe the freight-train handling instructions, as

contained in Air Brake Association Book No. 8, are ideal for freight-train holding and are used by us with very goods results. We only deviate from these instructions as regarding the total reduction to be released and the use of running position for releasing and charging. We also believe that with the above methods of train handling advantage is taken of the AB brakes in the train in the direction of expediting train movement with safety.

The Modified H-6 Brake Valve

To simplify the engineer's work in connection with train handling, we have modified our H-6 brake valves in such a manner that we now have a first service position and when used will make a 6 lb. brake pipe reduction and at the same time hold off the locomotive brake when the first reduction is being made. This will free the engineer to the extent that he can add to the throttle three or four notches while the brake-valve exhaust is discharging. Also changes in this brake valve give feed-valve pressure on top of the rotary valve with the brake-valve handle in release and running positions. Release position is used to release the brakes as this position gives full feed valve capacity whereas running position will choke down the valve capacity in order to give the conductor's valve proper control of the brake pipe. With this design, when releasing the brake valve is placed in release position 3 or 4 min. (without overcharge) and then returned to running position. This position, as above stated, will give control of the brake pipe to the conductor's valve.

The report was signed by W. E. Vergan, supervisor air brakes, M-K-T; J. H. Henley, road foreman engines, M-K-T; W. H. McCune, road foreman engines, M-K-T; A. H. Rothmeyer, road foreman engines, M-K-T; and S. L. Farney.

Discussion

In answering questions in the discussion Mr. Vergan, who presented the report, said that the modified H-6 brake valve was not intended to replace the No. 8 brake valve. He insisted, however, that if he were to apply the No. 8 valve it would have to provide an automatic lap at 6 lb. brake-pipe reduction just as does the first-application position in the modified H-6 type. It would also have to include the feature of the modified H-6 valve which prevents the application of the locomotive brake in first-application position.

Questions were raised as to the effect on fuel consumption of the use of the brake against the throttle. Mr. Vergan said that when slack developed in a freight train operating at high speed on track none too smooth, the vertical bouncing of the cars tends to cause the couplers to separate. He attributes the steady reduction in fuel consumption in freight service on the M-K-T to the reduction in break-in-twos which has eliminated the many delays formerly encountered. He referred to a reduction from as many as 125 knuckles in 30 days to five or six per month.

In replying to questions concerning the sticking of brakes following release from 6-lb. brake-pipe reductions, Mr. Vergan said that particular care was taken on the M-K-T to maintain tight brake pipes. Every car, at the principal terminals, he said, is tested with a portable test truck taking 20 cars at a time. He also stressed the statement in the report that an average of 20 per cent of the cars in M-K-T trains are equipped with AB brakes. Without the effect of these brakes in the train he said it would be impossible to handle the trains in this manner.

Mr. Vergan said that the modified H-6 brake valves are fitted with high capacity feed valves.

Stationary Boiler Plants

Consumption sufficient to justify detail study of plant designs

At many railway terminals an hour by hour study of steam, compressed air or power requirements may show a very uniform demand. Where the demand is fairly uniform it may almost be taken for granted that the base load represents standby losses. Radiation losses from steam lines, leaks, pumps or equipment operating continuously, whether needed or not, cause the uniform base load. A reduction or elimination of these wastes means a smaller but less uniform load on the power plant. If a new plant or replacement of main equipment in an existing plant is under consideration, a load study may make it possible to specify smaller units than would otherwise be considered. Steam used to operate boiler, washing and filling pumps, blower for firing up locomotives, fueling plants, etc., cause a very intermittent and variable load on a stationary boiler. Boiler equipment should, therefore, be designed to operate efficiently under a variable load.

The boiler, furnace and burning equipment should be designed for maximum efficiency during the medium load carried a long period of time and yet be able to carry the peak load, even at a light sacrifice in efficiency. This will probably be found better than to pay for the standby losses of an extra unit required but a few hours per day.

To express it in a little more detail: Far more than one boiler horsepower can be produced for each 10 or 11 sq. ft. of heating surface without damage to the metal if the right boiler with ample circulation, etc., is selected. If 10 or 11 sq. ft. of heating surface is provided for each boiler horsepower of normal load, there is no reason why two, three, or even four boiler horsepower cannot be generated for each 10 or 11 sq. ft. for short periods. The same is true of the furnace volume, grate area, etc. In some plants boilers should be designed to carry 150 per cent of rating peaks, and in others 400 per cent of rating.

A few years ago the majority of railway power plants burned coal in hand or stoker fired furnaces. Today natural gas, oil, pulverized coal, have come into general use. The market is flooded with new burning equipment for all of these fuels. The majority of this equipment may give excellent results if installed with the right boiler for certain load conditions. This merely makes the power plant man's job more interesting in the design and selection of equipment that will produce the best results at a given terminal at the least over-all operating cost.

If the average railroad burns from 8 per cent to 12 per cent of its fuel under stationary boilers, the total bill is sufficient to justify a detail study of new plant design or existing plant rebuilding.

The report was signed by R. S. Twogood, fuel engineer, Southern Pacific.

Why Not Streamline Statistics?

Suggestions for bringing out their pertinence in tables and by graphic presentations

Statistics, as a general class of product, in the typical statement form in which they are usually presented, are for the average man unattractive to the point of boredom if not to the extent of actual repulsion. The natural result of this situation is that the unhappy victim who must wade through a periodical deluge of such statements is inclined to avoid the journey or postpone the effort as long as possible, then plunge in and hurry through with all possible speed to more congenial mental territory beyond. Even to the statistically minded man it is too often the case that important relationships are so obscured and disguised that it is difficult if not impossible to discover and assign to them their actual or relative values. It is small wonder, then, that the laborious accumulation and marshaling of statistical data so often serves little of the intended purpose.

The general purpose of keeping records that permit the development and presentation of statistics at regular intervals on any subject under study is to show where we stand at any present time with reference to where we have been in various periods of the past and thus to determine the trend or direction of our progress, and if the operating officer is to be enabled to make any consistent use of such information as a guide in the formulation of plans designed to effect improvement in performance it is essential that the statistics that show the trend of performance be supplemented by other data that develop what are the causes responsible for the changes that may be observed in the trend of performance. It is well understood that data recorded for use for this purpose should be (1) pertinent, (2) accurate, and (3) promptly available.

But after we are assured that our material has been prepared in accordance with these principles, it is a commonplace observation that plain columns of figures paint no adequate picture of the subject under consideration even when there are no complicated inter-relations between the corresponding values in the different columns that may have been set up on a statistical statement. Of course, this deficiency is emphasized many fold when complicated interrelationships exist, as they surely do between the various factors represented in statistical presentations of locomotive fuel performance.

Fig. 1 shows an example of charting for a two year period of the monthly values of five factors of outstanding importance in their influence on the operating results of a railroad division: (1) Volume of business in million gross ton miles, (2) average temperature (on reversed scale), (3) average gross tons per train, (4) average engine load in gross ton miles per engine mile, and (5) average engine miles per 100 freight train miles. Correspondingly the monthly values of two factors representing important results of operation, are also shown: (1) Freight service fuel performance, pounds of coal per 1,000 gross ton miles, and (2) freight-train wage and fuel cost per 1,000 gross ton miles.

It requires only a glance at the chart to discover the extremely close correspondence between the volume of business on the one hand and the average train load and engine load on the other hand, between the engine load and the temperature on the one hand and the fuel performance on the other hand, and between all these factors and resulting wage and fuel cost per 1,000 gross ton miles.

It is particularly interesting to note the effect of unusual happenings upon all the factors and results of operation as shown by these charted values for the months of April and May, the period of the latest cessation of coal loading. This is the sort of presentation of statistical values that makes them tell a connected story, which the operating official who is studying his performance, can readily interpret with assurance that the comparative values and the relationships of the various factors have been properly appraised.

And now that there is a growing general appreciation of the value of form design, undertaken with the purpose of increasing the eye appeal of objects in general, particularly now that it is becoming almost standard railroad practice to streamline new locomotive and car equipment to attract the patronage of the traveling public, possibly the suggestion that we do what we can to "streamline" even so unattractive an object as the

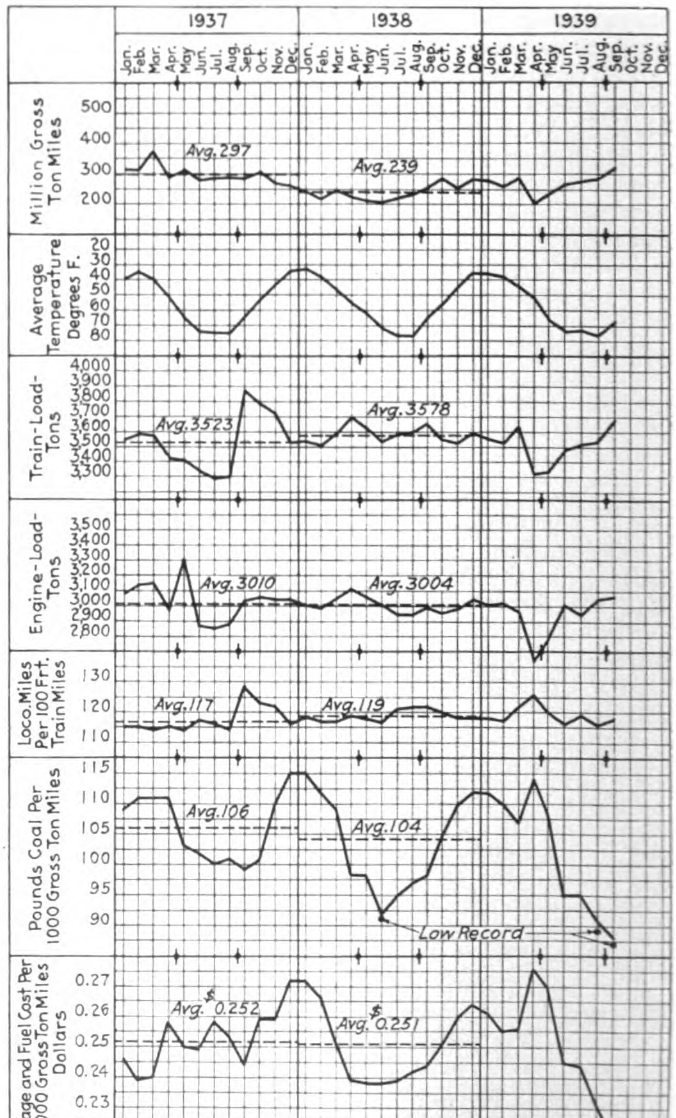


Fig. 1—Example of the method of charting five outstanding operating factors over two-year period, and two monthly factors

average statistical statement to make it more acceptable to its students may be found to be less flippant than it sounds at first mention.

By this proposal we mean simply to indorse the well-known principle that the average eye readily recognizes with accuracy the relative proportions of objects placed near together, which applies with particular force to such objects as parallel lines drawn on a scale diagram. We propose to advocate a more extensive use of graph-

Table I

From X	To Y	Service	No. trains	Train load	Engine load	Lb. coal per 1000 g.t.m.
		Scheduled	8	4042	3126	87
		Scheduled	2	2941	2941	158
Total	........Eastbound	Scheduled	10	3901	3106	94
		Scheduled	4	3606	2386	128
		Scheduled	1	2915	2915	153
Total	........Westbound	Scheduled	5	3516	2433	130
		Tonnage	3	7118	5297	64
		Tonnage	2	9730	9730	45
Total	........Eastbound	Tonnage	5	7855	6300	58
		Tonnage	5	2914	2914	125
		Tonnage	2	3331	2258	157
		Tonnage	1	2374	2374	123
Total	........Westbound	Tonnage	8	2830	2624	131
Total	........Scheduled and tonnage		28	4148	3357	96

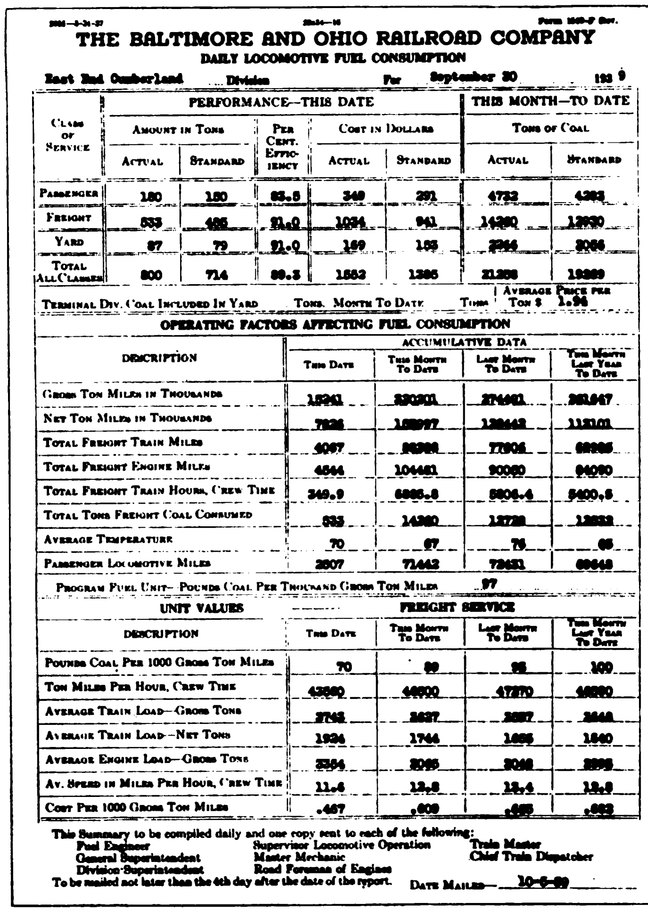
ical charts on which lines drawn to scale, or points set down to scale and connected by lines, are used to represent numerical values taken from the statistical statements. Without doubt, such graphical methods of presentation promote quicker visual comparisons of values, easier understanding of variations and stronger impressions of relationships than do the methods of simple tabulation that are in more general use. It follows that a corresponding saving of mental effort and time is thus accomplished for the busy officer who can hardly be expected to take time out for exhaustive analysis of statistical material.

In Fig. 2 we show an example of a divisional daily report of performance in freight service based upon the tabulation of values only, but employing a form of tabulation that has been made as attractive as possible by means of careful selection of both the factors or items covered and the comparisons that are set up.

It may be observed that the comparisons of the various items or performance factors for "This Date," "This Month to Date," "Last Month to Date," and "This Month Last Year to Date," constitute quite a complete analysis of the day-by-day operation of a division which may be grasped at a glance by the officer familiar with the territory.

But even so, we would advocate the use of the graphical method for showing the continuity of the daily values and the moving averages as they are published from day to day on even so well designed a tabular statement as this. While we have no knowledge of the regular use of such a chart we present in Fig. 3 a representation that we have prepared to illustrate the appearance of a month's data on Engine Load and Pounds of Coal per 1,000 Gross Ton Miles when set up in this form. From similar charts for preceding months laid side by side the comparisons with "Last Month" and "This Month Last Year" could be made at a glance.

In Table I, we show the next step in the analysis which the divisional officer would logically wish to make for occasional selected days, i.e., the performance of the groups of trains in each of the classes of service that make up his operation. In such a simple tabulation as this the contrasts in train load, engine load and unit fuel



THE BALTIMORE AND OHIO RAILROAD COMPANY

DAILY LOCOMOTIVE FUEL CONSUMPTION

East End Cumberland Division For September 30 1939

Class of Service	Performance—This Date: Amount in Tons, Actual	Amount in Tons, Standard	Per Cent. Efficiency	Cost in Dollars, Actual	Cost in Dollars, Standard	This Month—To Date: Tons of Coal, Actual	Tons of Coal, Standard
Passenger	180	150	83.5	349	291	4732	4293
Freight	533	485	91.0	1034	941	14280	12930
Yard	87	79	91.0	169	153	2246	2066
Total All Classes	800	714	89.3	1552	1385	21258	19289

Terminal Div. Coal Included In Yard Tons. Month To Date Tons | Average Price per Ton $ 1.94

OPERATING FACTORS AFFECTING FUEL CONSUMPTION

Description	Accumulative Data: This Date	This Month To Date	Last Month To Date	This Month Last Year To Date
Gross Ton Miles in Thousands	15241	320201	274461	261647
Net Ton Miles in Thousands	7826	158977	128442	113101
Total Freight Train Miles	4067	86288	77906	69865
Total Freight Engine Miles	4544	104481	90060	84080
Total Freight Train Hours, Crew Time	349.9	6886.8	5806.4	5400.5
Total Tons Freight Coal Consumed	533	14280	12728	12032
Average Temperature	70	67	76	65
Passenger Locomotive Miles	2507	71442	72631	69648

Program Fuel Unit—Pounds Coal Per Thousand Gross Ton Miles 97

UNIT VALUES — FREIGHT SERVICE

Description	This Date	This Month To Date	Last Month To Date	This Month Last Year To Date
Pounds Coal Per 1000 Gross Ton Miles	70	89	93	100
Ton Miles Per Hour, Crew Time	43560	46500	47270	48380
Average Train Load—Gross Tons	3748	3627	3687	3848
Average Train Load—Net Tons	1924	1744	1665	1640
Average Engine Load—Gross Tons	3354	3065	3048	3098
Av. Speed in Miles Per Hour, Crew Time	11.6	12.8	12.4	12.8
Cost Per 1000 Gross Ton Miles	.467	.609	.635	.632

This Summary to be compiled daily and one copy sent to each of the following:
Fuel Engineer; Supervisor Locomotive Operation; Train Master
General Superintendent; Master Mechanic; Chief Train Dispatcher
Division Superintendent; Road Foreman of Engines
To be mailed not later than the 4th day after the date of the report. Date Mailed— 10-6-39

Fig. 2—Divisional daily report of performance in freight service, using tabulations only

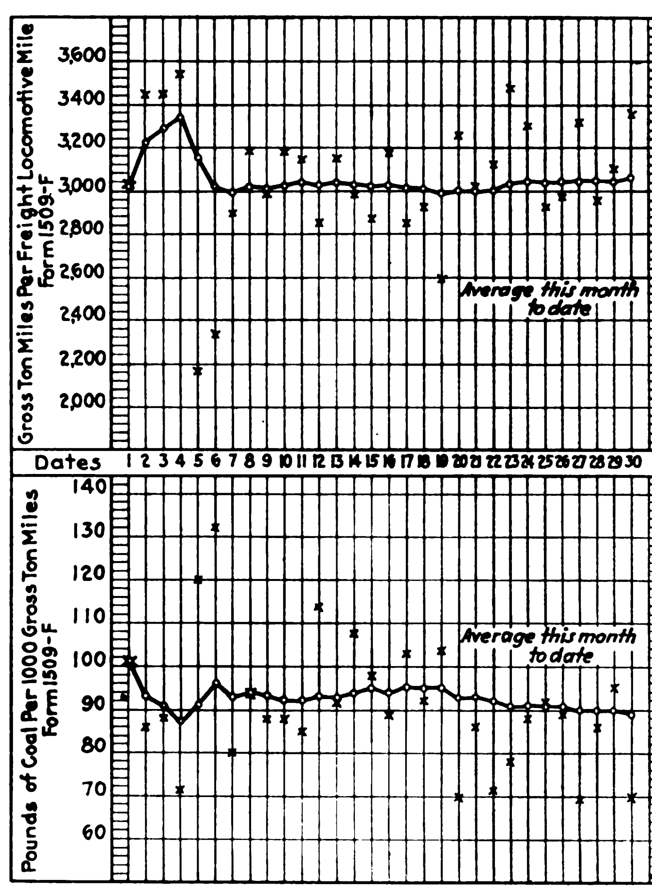


Fig. 3—One month's data on locomotive load and fuel used

consumption, as between different groups, is sufficiently striking without the use of graphical charts. It becomes obvious that certain groups may be selected for special attention with the object of improving the general average, in which case the analysis would naturally be carried down to expose the performance of individual trains.

We consider it important to emphasize the opinion that, no matter how attractive the presentation may be made, there is only a very limited value to be derived from statistical data as guides to control of current trends of operating performance if they are not made available within a few days after the date or after the close of the period they cover. While statistical statements published five to eight weeks after the period may be useful and necessary as records of past performance, as, for example, is the case of the O. S. Reports to the Interstate Commerce Commission, it is obvious that they are not available early enough to be used to influence current trends of operating performance.

The report was signed by E. E. Ramey (chairman), fuel engineer, B. & O.; G. E. Anderson, general fuel supervisor, Great Northern; P. E. Buettell, fuel supervisor, C. M. St. P. & P.; A. A. Raymond, superintendent fuel and locomotive performance, N. Y. C., and E. G Sanders, fuel conservation engineer, A T. & S. F.

Preparation, Inspection and Utilization of Coal

Washing improves many coals—Make thorough mine inspections—One coal per engine district

In recent years careful preparation has become the rule in the coal industry. Decreased demand for coal because of slackened industrial activity and the inroads of competitive fuels have forced upon the coal industry the need of dressing up the product. Of necessity the alert producer must keep up with progress in coal preparation. Great forward strides have been made in the last two decades. Today coal is washed, dried, sized, dust-proofed, medicated and inspected so as to insure the consumer the maximum in quality and uniformity for his fuel dollars. Care is taken in every step of preparation from the initial loading until the finished product is lowered into the railroad car. Each step is important.

Preparation

Coal preparation at the tipple may be classified into the following sub-divisions: sizing, cleaning or removing of impurities, surface treatment to allay dust, and mixing and blending.

Most tipples are equipped with elaborate screening and rescreening installations such as high- and low-speed shaker and vibrator screens, special conveying and assembling equipment, picking tables and loading booms. The raw coal is fed on to screens for separating into various sizes; namely, block, lump, egg, stove, nut, pea, screenings, duff, modified mine run and various resultant sizes. In addition to these grades some of the mines are equipped with storage bins and mixing conveyors which enable them to load almost any size or combination of sizes that a consumer may demand.

The concentration of the industry on preparation of ideal stoker coal sizes has brought about a number of developments in screening equipment. Reasonably satisfactory screening of coal at sizes as small as forty-eight mesh has been made possible.

After having been separated into different sizes coal is subject to breakage in both hand and mechanical cleaning plants, therefore, modern tipples are equipped with degradation screens to remove this breakage of undersized coal. Many of the mine tipples are equipped with crushers and cross conveyors. This is particularly desirable when mines are supplying railroad fuel to purchasers of run of mine coal who specify that the lumps must not exceed a maximum top size.

Hand-picking is still the method by which most coal is cleaned. Where it is the sole cleaning method employed, all prepared sizes down to approximately 1¼-in. bottom size are generally cleaned. Separate picking tables are provided for each of the prepared sizes. Most plants having mechanical cleaning equipment still rely on hand-picking for the larger sized coal above four or six inches. This is because it is easier and more economical to remove the larger sized visible impurities in this manner.

It has been found that mercury vapor lamps increase the contrast between sulphur pyrites and pure coal. Therefore, this type of illumination is in extensive use for picking coal in which pyrites are common. On the other hand, the light from mercury vapor lamps tends to deaden the lustre of coal so that slate appearing with the coal does not stand out as clearly as when incandescent lamps are used. The character of the impurities determines which type of picking-table illumination is more efficacious.

Sized coal is delivered to the railroad cars from modern loading booms with the minimum of degradation. A new feature built on the end of the loading booms still further guards against the breaking up of coal as it falls in the car. This feature consists of two flat steel aprons so mounted at the end of the loading boom that the coal slides down into the cars. Another improved method now being used successfully is layer loading, which is a new departure from general loading practice. Layer loading consists of loading two or three cars in tandem, which materially reduces segregation and makes possible greater uniformity of coal quality.

Competition with oil and gas in the domestic market and keen competition within the coal industry has caused many producers to install equipment in the tipples to spray coal with various kinds of dust-allaying media. A number of industrial plants are specifying dust-treated coal. The railways as a whole have not given this subject serious consideration although one or two companies, such as the Richmond, Fredericksburg & Potomac, have conducted some investigation in this direction.

There are but few mines that are equipped to mix and blend coal. Unfortunately run-of-mine coal from the same mine or different mines does not run uniformly as to size. Appreciating this condition some of the operators have installed storage bins and mixing conveyors to insure uniformity of size in every car of coal shipped.

An addition to the efficiency of preparation that is typical in the industry today is mechanical cleaning. The advantages claimed for such a refinement are many and varied. Any reduction in ash content represents a corresponding increase in heat value. The benefit to the consumer is considerably greater than the apparent increase in heat value. The burning characteristics of

washed screenings may be different from the same coal in the raw state. Less slagging, maintenance, and boiler outage with washed coal is the experience of many stationary boiler plant operators.

A very important advantage of washing coal is the relative uniformity of the product. The ash content of raw screenings will often show wide variations from the average from day to day. Lack of uniformity is expensive to the coal user because few types of burning equipment have the flexibility necessary to burn successfully alternately low- and high-ash coal. Excess ash or low heat value may mean that a plant must shut down because of inability to carry the steam load.

Some coals cannot be economically washed. The structure of the coal and the impurities inherent and extraneous, vary not only with each coal seam, but also with each mine and within each loading day. Modern automatic washing units, because of their great flexibility, can successfully clean our midwestern coals to a reasonably uniform desired ash content. Because of the concentration of impurities in the small sizes of midwestern coals, washing reduces the ash in the small sizes to a much greater degree than it does in the prepared sizes. In some coals, the ash content of the screenings after washing is less than the ash content of the larger sizes. In making the decision to wash a particular coal, the percentage of ash desired in the washed product must be decided. The character of the impurities and intermediate coal may determine this.

To emphasize the benefit derived from washing 1¼-in. screenings, the following are averages of several analyses made on three Illinois group mines designated as follows:

Classification	Ash, per cent		Sulphur, per cent		B.t.u.	
	Raw	Washed	Raw	Washed	Raw	Washed
High grade	11.50	7.96	1.99	1.03	12,590	12,900
Medium grade	12.38	9.61	3.40	2.81	12,440	12,890
Low grade	16.71	7.69	3.94	2.09	10,260	12,260

The increased use of mechanical loading devices in underground mines and the rapid growth in strip-mine operations has made mechanical cleaning of coal practically mandatory. Such mining methods not only load all the impurities contained in the coal seams, but in many cases also part of the roof and the clay or rock bottom. It requires heavier shooting in order to break down the larger lumps of coal and consequently produce a tipple mixture with which hand picking methods cannot hope to cope. There are also certain seams where even if the coal were hand loaded, the size and the distribution of the impurities make it next to impossible to properly clean the coal by hand. It is here that the mechanical cleaning process must step in. As far as the purchaser is concerned, the end results of mechanical cleaning methods are about equal. Practically every different cleaning system will produce the same grade of coal from any certain coal seam.

It would seem as though a new series of tests on washed fine coal such as 2-in. and 1¼-in. screenings would be helpful in pointing the way to the increased use of fine coal. Since mechanically cleaned coal is practically dustless there should be a reduction in honeycomb formation on tube and blue sheet, less ash to dispose of from the fuel bed, less handling at the cinder pit and less unburned coal passing through the boiler and out the stack.

With the use of mechanically cleaned coal smaller than 7 in. by 0 or 6 in. by 0, such as 2 in. by 0, segregation is further reduced with beneficial effects. If 2 in. by 0 coal was supplied exclusively to stoker-fired locomotives the degradation in passing through the stoker delivery apparatus would be materially reduced.

A problem that naturally follows the washing of coal is the treatment of the screening sizes to remove excess water which is objectionable for a number of reasons. First, the user does not want to pay for water that detracts from rather than adds to the evaporation efficiency. During the winter it is important to remove excess moisture in order to prevent freezing. The practice of dewatering washed coal is far from being standardized. There are no two preparation plants that meet the problem of dewatering in exactly the same manner. The absence of uniformity in dewatering equipment would seem to indicate that the question of dewatering is not a settled one.

Most plants equipped with washers supplement mechanical dewatering and drying of screenings with the addition of calcium chloride or granulated salt in extreme cold weather. The remaining extraneous moisture in the fine sizes after dewatering is concentrated through gravitation to the bottom of the railroad car. Difficulty is sometimes encountered in zero weather in opening the pockets of hopper cars because this concentration of moisture in the pockets results in freezing. This freezing does not occur when ⅜ in. or 5/16 in. down is heat dried. At plants not equipped with heat driers the addition of a chemical agent such as calcium chloride in the bottom of the pockets may prevent freezing.

Inspection

It is understood by all of the railroad fuel inspectors and fuel inspection departments that the proper place to inspect coal is at the mine, and that it is necessary to be familiar with the mine's operation, preparation facilities and practices so that intelligent decision can be made as to what to expect. Such inspections should be thorough. In other words, the coal inspector should spend a whole day at various times going through a coal company's plant and observing every detail of operation. He will thereby make the contacts and see enough of the coal to be able to tell definitely what quality it is. This is far better than spasmodic inspection at the mine or on the tops of cars, or a few unloaded cars at destination. With this knowledge the inspector knows what mines may have difficulty in furnishing satisfactory coal either from the standpoint of their mechanical equipment above or because of their method of loading the coal underground. Coal not complying with contract requirements or specifications should be rejected and the reason for rejection given. Good inspection entails surprise visits. Therefore, the inspector should not be required to follow any set routine, which will hamper him in the proper functioning of his duty.

As it is physically impossible to have a large enough inspection force to see every car from every mine during each mine's working day, much can be accomplished by having the coal-chute, stationary boiler-plant and roundhouse foremen report on the coal. If it seems to fall short of the specifications, then a sample of the impurities found should be collected and saved for the inspector so that a proper investigation can be made at the mine. Reports to the inspectors or fuel department headquarters on such inspections and samples collected have much to do with the elimination of stoker failures, steam failures and fuel losses which otherwise might be overlooked.

The sampling of coal is something that should be done with great care. Incorrect sampling or spasmodic sampling of coal does more harm than good. As has already been said, the best place to sample coal is at the mine. Any coal operator who will not co-operate in this respect is not a good producer of coal, no matter what his product is like. At large mines and where they have

cleaning plants, provision is usually made for automatic sampling. If a sample of the complete day's run at the mine is taken, it will usually show a true representative analysis of the mine's average coal quality. Most operators having cleaning plants or large tipples, usually make provision for collecting samples of daily runs and in most cases, collect them for their own information. It is only necessary to co-operate with the producer in order to get a portion of his sample.

The inspectors must keep a close check on the coal cleaned in a mechanical cleaning plant because these plants can be adjusted to produce any desired ash percentage above a given minimum. When the cleaning control adjustment is changed, it means an increase or decrease in ash percentage, that is the impurities loaded out with the coal.

Foreign material is occasionally thrown on top of the loaded coal cars while enroute and it is possible for this foreign material to become mixed with the coal. Therefore it is necessary to make top inspection of each load before the unloading process is started then to watch the car's contents as they are being unloaded. This care reduces possible failure and expensive breakdowns of mechanically operated devices on our locomotives and in our stationary boiler plants. The coal chute and boiler room attendants should be instructed to make these inspections.

Utilization

Fuel used by railroads is normally from coal fields near at hand or coal which is most easily and most economically obtainable. Owing to these considerations practically every variety of coal available is used to greater or lesser extent by the railroads. If all coals were similar in physical and chemical characteristics and if locomotives and stationary boiler plants were designed to burn all sizes and kinds of coal with equal combustion efficiency, selection of locomotive and stationary boiler plant fuel coal would be greatly simplified. The methods employed by individual railways in handling coal from railway cars to locomotive tender has a material bearing on the grade or size of coal which can be used. The modern railway coaling station is equipped with shaker screens, crushers and adequate bins or pockets to store the various kinds and sizes of coal required on different types of locomotives. A stoker coal is furnished to stoker-fired locomotives and egg, stove or resultant sized coal delivered to hand-fired passenger, freight or yard locomotives. If the coal station has only one pocket, which only too frequently is the case, the purchasing agent is forced to buy a coal that can be used on both stoker- and hand-fired locomotives. This results in increased consumption of fuel.

Another important factor is the question of coal segregation in passing through the coaling-station bin. Regardless of the attention given to the preparation at the mine, if provision is not made to prevent segregation in the coaling station trouble will be encountered, even stoker coal segregates into various sizes and as a result one locomotive tender is supplied with a super clean nut or pea size and the next one receives practically all "bug dust."

Inasmuch as the geographic economic considerations make it necessary for railroads that do not originate coal to draw their supply from widely separated coal fields, coal handling facilities, type and design of locomotives, etc., govern the grades and sizes of coal that can be used. Any discussion of coal selection and utilization cannot proceed, except in the most general terms, unless the controlling factors governing an individual railroad are known.

The importance of placing one grade of coal in the various coaling stations along the route of a single locomotive run cannot be over emphasized as some firemen, especially on stoker-fired locomotives, in going from one type of coal to another will experience some difficulty in properly regulating the jets and stoker speed.

Consideration should also be given the matter of unloading coal currently and not allowing it to deteriorate for months under the summer sun and rain merely because it is more convenient for yard forces to spot the coal that was last received from the mine.

The proper loading of cars is also essential. An overloaded car results in a direct loss of fuel.

Pilferage must also be considered here. While it may be practically impossible to stop all thievery, much can be accomplished by not placing cars near public road crossings, driveways and other spots that are accessible to the public. Police protection around the coal chutes, coaling tracks and yards is practical because in many instances such protection is already being provided in the vicinity for other purposes. At some points it has been found advantageous and economical to provide police protection solely for the company coal.

With the rapidly increasing number of stoker-fired locomotives it will be beneficial to purchase a size of coal that will not have to be crushed. Most types of stoker-fired coal conveying equipment crush the coal to a minus 2½ in size. Consequently, when larger coal is supplied to the tender of a stoker-fired locomotive, extra power is required to reduce the size so that it can be conveyed through to the firing table. This, in turn, results in a heavier percentage of fines, increased fuel consumption and a higher machinery maintenance expense.

The unloading of cars at the various points should be checked closely to see that all the coal is unloaded before the cars are moved away from the unloading spot. The cinder pit and ash pit accumulation should be observed closely as they are good barometers of what is happening on the road or in the boiler room.

The reclamation of the carbonaceous or combustible material that is found in the cinders and ashes prior to being loaded out as refuse for disposal should be given serious thought and consideration especially with those roads which do not originate coal on their own line. There are several types of mechanical separators used for reclaiming loose combustible substances for use in generating steam in several European countries. These separators are known as "pan ash separators" and are of the wet-jig, trough and upward-current types. These Pan Ash Separators are easy and cheap to operate and have proved their worth over several years of operation in European countries.

Since the advent of extended locomotive runs some of the through run locomotives are coupled to tenders that have a limited coal carrying capacity. This means that these tenders must be coaled to their extreme loading limits at certain coaling stations along the line in order to assure the crew an adequate supply of coal to haul the train to the next scheduled coaling stop. The result of such a practice is overloaded tenders which means loss of coal. Some other operations are supplied with tenders that have too large a coal capacity. Consequently, the coal in the back of the tenders remains there from one shop or roundhouse tender cleaning period to another. This results in deteriorated coal which means a loss of heat. Loading or coaling tenders to their maximum capacity when it is not necessary should be stopped as this practice is a deliberate waste.

The report was signed by S. A. Dickson, (chairman), supervisor fuel, Alton; H. J. Brielmaier, supervisor fuel inspection, Wabash; P. E. Buettell, fuel supervisor, C. M. St. P. & P.; R. W. Butler, fuel inspector, C. & O.; L. J. Joffray, chief fuel inspector, Illinois Central; W. A.

Larick, supervisor fuel, N. Y. C.; Hugo B. Lee, Jr., The Maumee Collieries Co.; A. F. McElhenie, The Pittsburgh & Midway Coal Mining Company; R. H. Morris, The Gauley Mountain Coal Company; Geo. G. Ritchie, fuel service engineer, C. & O.; W. L. Sheppard, Pittsburgh Coal Company, and W. J. Tapp, fuel supervisor, D. & R. G. W.

How Can the Members Help the Association?

E. L. Woodward, western editor, *Railway Mechanical Engineer,* presented a paper on the subject "What Each Member Can Do To Promote the Effectiveness of the Railway Fuel and Traveling Engineers' Association." His paper was based on suggestions received in letters from 22 members. Those most frequently mentioned which Mr. Woodward placed at the top of the list are as follows: (1) Members should study advance copies of all committee reports and papers so that they will be able to discuss them intelligently; (2) each member should attend every meeting and support the work of the association by paying his dues in advance; (3) members should make it a definite responsibility to sell the association to the higher officers on their railroads, and (4) members should accept assignments to committees and should help in the preparation and presentation of committee reports; the work of the committee should not all be left to the chairman.

Car Association--- Freight Car Inspection

(*Continued from page 465*)

In the foregoing recommendations particular attention is called to the necessity of making special inspection and adjustment of certain parts of cars for specified service. This does not mean that the instructions governing the inspection or repairs to any part of any car used for some other service can be overlooked, but that the parts mentioned are the most vital in affording the required protection for the class of service under consideration.

Conditioning Cars after Loading with Hides and Fertilizers

Cleaning and deodorizing of cars contaminated by the loading and transportation of such products as hides, fertilizer and other commodities listed in A. A. R. Transportation Division Cir. T-42-A, dated October 25, 1938, has been given a great deal of thought and some progress has been made, but much remains to be done. Compliance with the regulations and instructions contained in Cir. T-42-A would, to a very large extent, preserve the better class of cars for high grade commodity loading and with a corresponding reduction in cost of cleaning and reconditioning of cars.

During the past year one northwest road, after much experimental work in developing facilities and practices, reports that they have been successful in cleaning and deodorizing box cars that were badly contaminated from hide or other contaminating commodities at only a fraction of which it would have cost to replace flooring and necessary lining. Cars were cleaned during all seasons and approximately 85 per cent of all cars cleaned were made OK for high class commodities.

When a car arrives at a station or terminal point with floors or walls in a contaminated condition, and such contamination will cause damage to subsequent loading, it is the duty of the station forces or car inspectors to card and forward such cars empty to the properly assigned and designated repair or wash cleaning tracks where these cars may be cleaned, reconditioned, and made serviceable for highest class lading. When completed, they are properly classified or commodity card applied.

For the past many years the improper use of and damage to the better classes of freight car equipment caused by the loading and transportation of contaminating commodities has reached such a volume that cooperative effort among railroads, and between railroads and shippers is necessary, not only to avoid excessive costs of reconditioning equipment for the original service for which it was provided, but also to depletion of equipment available for high class loading, as well as damage to various commodities loaded in contaminated cars. Much of this can be avoided by employing regularly assigned cars for hide service or contaminated products as well as reconditioning of misused cars through the proper cleaning procedure.

Loading of hides in first class house cars is very detrimental to the equipment, causing very offensive odors as well as damage to commodities therein loaded while in such a contaminated condition. Hides produce various forms of detrimental effects on the interior portion of the car because of the manner in which they are shipped. There are forms of bacteria, or one-celled microscopic organisms which grow and increase by the millions if in a warm or moist place. Also, hides not properly cleaned, having an accumulation of fat, produce a rancid odor caused by the formation of butyric acid. This drips or falls from the hides, lodging into the crevices of the wood. Then again, there are forms of fungi formation which are plantlike growths or moulds that form on the fur portion of the hide. This also dislodges or falls from the hide onto the floor or sides of the car. The cars are possibly warm and moist, giving it a good medium to grow in within the crevices of the wood, and will continue to grow until removed. All of this causes offensive odors inside of the car and contaminates commodities loaded therein, unless removed.

By the proper cleaning procedure as described herein, the use of proper cleaner solution, tests have proven that this solution properly used will extract all this contamination from the car with very little expense. This solution acts as a disinfectant, cleaner, and deodorizer and has practical applications.

This committee will be glad to furnish interested members with trade name and manufacturer of the chemical compound used for cleaning as above outlined.

Coal cars should, of course, be given the same attention as to condition of trucks, sills, draft gear, brakes, safety appliances, etc., as box and other cars. Doors and door operating mechanisms should be carefully inspected when cars are empty to see that these parts are in proper condition before cars are loaded. Sides, ends and bottom should be tight enough to handle the kind of coal for which furnished to destination without loss.

Stock cars, in addition to being in good running order, should be given careful inspection to see that there are no protruding bolts, nails or projections of any kind that would injure stock.

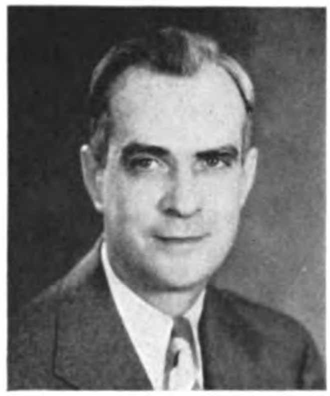
The report was signed by Chairman F. G. Moody, master car builder, N. P.; F. J. Swanson, general car department supervisor, C. M., St. P. & P.; P. J. Hogan, supervisor car inspection and maintenance, N. Y., N. H. & H.; F. M. Rezner, general car foreman, C. B. & Q.; and E. A. Sweeley, mechanical superintendent, Burlington Refrigerator Express Company.

(*The report was accepted and ordered printed.*)

New Association Discusses Problems of

Locomotive Maintenance

F. B. Downey, President



J. W. Oxley
First Vice-President

J. C. Miller
Third Vice-President

Locomotive department supervisors hear papers and talks on training supervisors, apprenticeship, heat treating, scheduling and tool selection

OVER 100 members and guests registered at the Hotel Sherman, Chicago, for the three-day meeting of the Locomotive Maintenance Officers' Association which met for its first session on Tuesday morning, October 17. At the opening session this association met jointly with the three other mechanical groups meeting at Chicago to listen to an address on the training and coaching of supervisors by L. W. Baldwin, chief executive officer, Missouri Pacific. Mr. Baldwin's address appears elsewhere in this issue.

At the afternoon session of the first day President Downey spoke at length on the scope and purpose of the reorganized association. He reviewed the work of the former International Railway General Foremen's Association and drew attention to the fact that under the old organization the membership was drawn from a limited group, principally general foremen, in the locomotive and car departments. When the former organization temporarily suspended its meetings during the early years of the depression there was, he pointed out, a move made to co-ordinate the activities of several of the so-called minor associations which resulted in the formation of the new association under its present name, with its membership limited to railroad men interested in the problems of locomotive maintenance but expanded in scope so as to include master mechanics, shop superintendents, shop engineers, machine tool supervisors, chief locomotive inspectors and their assistants as well as general shop and enginehouse foremen. Its activities, he said, will embrace all phases of locomotive repairs.

At later sessions addresses were made by F. E. Lyford, trustee, New York, Ontario & Western, and D. S. Ellis, chief mechanical officer, Chesapeake & Ohio, and the following technical papers were presented: Roundhouse Problems Caused by Long Runs, by F. J. Fahey master mechanic, New York Central; Training of Apprentices by A. H. Williams, general supervisor of apprentice training, Canadian National; Forging and Heat Treating Locomotive Parts by L. B. Herfurth, forging supervisor, Missouri Pacific; Failures of Locomotive Parts and How to Prevent Them* by F. H. Williams, assistant test engineer, Canadian National; Scheduling Locomotive Through the Shops for Classified Repairs by F. B. Downey, assistant shop superintendent, Chesapeake & Ohio and Methods for Selecting Machinery and Tools for Locomotive Repairs by R. P. Dollard, shop engineer, Chespeake & Ohio.

Election of Officers

At the afternoon session on the last day of the meeting, the following officers were elected for the ensuing year: President, F. B. Downey, assistant shop superintendent, Chesapeake & Ohio; first vice-president, J. C. Miller, general foreman, Nickel Plate Road; second vice-president and secretary-treasurer, J. E. Goodwin, shop superintendent, Missouri Pacific; and third vice-president, F. J. Topping, assistant master mechanic, Chesapeake & Ohio. The following members were elected to the executive committee: F. T. James, master mechanic, Delaware, Lackawanna & Western (chairman); F. W. Ekins, general foreman, Atchison, Topeka & Santa Fe; W. L. Jones, general foreman, Illinois Central. J. B. Dunlop, superintendent car shops, Canadian National and W. L. Rice, superintendent of shops, Reading, continue as members of the executive committee.

* An abstract of this paper, with illustrations, will appear in a later issue.

The Qualities of a Good Supervisor

By F. E. Lyford

Trustee, New York, Ontario & Western

As a result of having spent several years as a supervisor in the mechanical department, I have often felt that the mechanical department of a railroad does not get the recognition to which it is entitled. Roughly speaking, the mechanical department is responsible for the expenditure of about 20 per cent of the gross revenue of railroad operation and I believe that there are many executives who do not recognize the tremendous effect that this expenditure has on the operation of a railroad. Executives are prone to think in terms of cars and their contents and the revenue which they bring in, overlooking the importance of the locomotive which pulls the train. This is a most important unit, and they should see that everything possible is done to provide the mechanical department with the facilities necessary to reduce transportation to its lowest possible cost by keeping equipment in the best of condition.

It seems to me that mechanical department supervisors have been somewhat at fault in the attitude they have taken. In the hurry and rush of the enginehouse or shop they are likely to concentrate on getting a job out quickly in spite of the fact that it may not be thoroughly done. Because of this fact, it is necessary many times to do a job over and this repetitive work causes a waste of labor and material that can be prevented by adequate and intelligent supervision.

"Adequate supervision is the essence of good management, and management is not merely that of the head of an organization. An executive has a right to expect certain things of his supervisors, and there are four or five of these that seem to me to be of great importance.

First, an enginehouse or shop foreman, or a superintendent of motive power, should be one of the most curious fellows in the world. He should always be asking why he should do this and why he should do that. Curiosity will save him a lot of expense and will help him if he puts it to good use. Men should be curious about the jobs that are ahead of them in order that they may be ready to step into them. Many executives and supervisors are too inclined to use the old army system of merely giving an order and not explaining what the reason is back of the order. The right men are curious about reasons and will do a better job when the reason is made clear. I had a little difficulty with a supervisor on our road recently. He was given a budget and when he overran it I called him in and asked him why he had done it. I explained to him that there was just so much revenue and that if every one ran over his budget we would all soon be out of a job. Then I showed him the company's operating figures and explained them to him. Finally, he said that this was the first time anybody had told him about the financial condition of the road, and now that he knew what the problems and difficulties were he would not overrun the budget again. From then on everything ran in good shape. I felt that he, as a supervisor, had the right to know and that he could work better if he knew what was behind all this. You will observe that your men are curious to know certain things, and if you explain matters of policy and change, you will soon realize how interested they are in their jobs.

The second matter is that of supervisors being mentally and physically alert—looking like a supervisor and acting like one. The type of foremen who is constantly running around with his pockets full of papers may look busy but it does not mean that he is accomplishing much. The alert supervisor is the man who learns very quickly the important things to watch and by asking questions concerning these certain key factors can rapidly size up any situation.

The third factor is resourcefulness. Resourcefulness is one of the most valuable assets that a mechanical supervisor can have. It is not only necessary in its application to the use of machine tools and small tools, but is just as necessary in the use of information that comes to his attention. The resourceful supervisor is always able to find just the right solution to a problem and the ability to use vital information properly is sometimes one of the easiest roads to the right solution. Statistics—vital statistics concerning the operations of the road and department—are of great value to a supervisor in running his job intelligently and he should train himself to recognize what the vital statistics are.

The fourth factor is promptness. Time is essential on every railroad and things must be done on time. Promptness should be observed in recommending new equipment, new tools and in falling in line with new methods. Be prompt about the situation that seems of utmost importance to you—do your job efficiently but be sure that you have it done on time. You should give your men the help they need to enable them to do their jobs quickly. Often this need only be a clear explanation.

The last one of the factors is the question of honesty. A lot of supervisors are not honest with themselves because they are stubborn and refuse to recognize both sides of a question. It is necessary that a supervisor have his mind wide open at all times so that he can honestly approach each and every problem that he meets. Upon honest supervision depends the lives, safety and jobs of millions of people.

In conclusion, I want to say that the railroads are probably the most important industry we have and are going to have for some time, but the mechanical forces are of utmost importance in this industry—that good equipment is fine but good men are better—you can do a lot with good men and poor equipment but not much with good equipment and poor men.

J. E. Goodwin
Fourth Vice-President

F. T. James
Secretary-Treasurer

Proper Maintenance of Modern Locomotives

By D. S. Ellis

Chief Mechanical Officer, Chesapeake & Ohio

The modern locomotive is called upon to produce higher sustained horsepower over longer periods of time and at higher speeds than those formerly existing, and must be in such condition at all times to meet these exacting requirements. Above all else, it must not be the cause of delays enroute. This leads us to the question at hand—the proper maintenance of locomotives.

This problem has become somewhat complicated due to the addition of various auxiliaries. It is my honest opinion that the proper maintenance of a modern locomotive will be better accomplished if we do a little more work with our heads before we start in with our hands. In other words, first analyze the problem at hand and then set up the necessary machinery in the form of proper schedules, based on mileage or time, for doing certain work and when we do tackle the actual job of accomplishing it, do it right—go all the way, not halfway, turn it out as nearly 100 per cent right as it is humanly possible to do. Proper scheduling of repairs in advance is of utmost importance.

Co-ordination and co-operation between departments is essential in order that the assigned mileage and the highest availability possible for the modern locomotive can be accomplished.

A Problem in Economics

Like all railroad problems, that of locomotive maintenance is one of economics, and a definite plan carried to its logical conclusion is vital. This requires the use of a definite measuring stick to determine when a locomotive should be shopped and for what purpose. This measure or barometer is usually assigned mileage, but this alone is not the whole answer for it is essential that it be supplemented by a detailed inspection of work necessary, covering the true condition of the unit before it is shopped. When the locomotive is finally placed in shop for repairs, these repairs should be made in the proper manner, performing each job by the means found best to suit the condition at hand. I would suggest at this point that it is very helpful to first study the job to be done, then the best means of accomplishing it economically, and set this up as a standard.

It is quite essential, when locomotives are shopped for repairs, that each shop supervisor consider the purpose for which the locomotive is shopped, and it should be his aim to see that all work necessary is performed to keep the locomotive in service, barring unforeseen accidents, until it has made its full cycle of mileage, and so that it does not become necessary to make major repairs at terminals between shopping periods.

For example, crown brasses and cylinder bushings which, in the judgment of the supervisor or as previously established by practice, are not in condition to make the full assigned mileage, should be renewed to eliminate the necessity of renewal between shoppings, thereby relieving the engine terminals of such major work. If the foregoing is carried out diligently, I dare say that the enginehouse job in maintaining modern locomotives will be greatly lessened and the economies to be derived therefrom innumerable.

Thorough Inspection Important

Going back to the maintenance of modern locomotives in regular service between shopping dates I recommend careful, detailed inspection and prompt performance of all work necessary prior to dispatchment of the locomotive so that when the locomotive is dispatched, the supervisor can rest comfortably in the knowledge that the locomotive will go out on its run and make its trip without causing any delay whatever to transportation insofar as mechanical details are concerned.

As in the case of the back shop supervisor, the enginehouse supervisor should at all times do the necessary work. Of course, it is understood that before the work can be done, the defects must be found, and, in many instances, herein lies the secret about engine failures which result in such costly delays.

Carrying this thought still further and supplementing the work required by Federal Rules with those rules we know are necessary, namely—a complete, detail inspection of the locomotives each 30 days, and making the necessary repairs to keep the engine in service during the next 30 days is likewise most essential.

I would seriously recommend to you at this time, if you have not already done so, the creation of a so-called standardized monthly inspection, or No. 1 Inspection Report, and instructions pertaining thereto, for if properly carried out the performance of the work thus reported will go a long way toward reducing engine failures and ultimately major repairs. The same thing, likewise, applies to so-called quarterly and annual inspections.

What I am trying to bring out here is my former reference to co-ordination, for it is only through the co-ordinated effort of those responsible for the proper maintenance of modern locomotives, through each of the various inspection and repair operations mentioned that modern locomotives will be properly maintained.

It is also important that we, as supervisors, familiarize ourselves with, and know the condition of each unit under our direct supervision. In other words, the mechanical head of the department will know this in a general way—the master mechanic in a still more complete way so far as the number of units under his direct supervision are concerned—the general foreman—the enginehouse foreman—and the inspector, in complete detail. If all of those mentioned will study and know the condition of their individual engines, at all times, the job of maintaining the modern locomotive becomes much more simple.

Both back shop and enginehouse supervision should be thoroughly familiar with all machine tools assigned to them as well as facilities over which they have jurisdiction, in order that they may at all times so arrange and plan their work that the maximum use and benefit from each tool will be derived. This is particularly true today because of the cost of our present modern equipment.

No talk of this nature would be complete without due reference to the training of shop and enginehouse forces in such a manner that each man may perform his work in the most efficient manner possible and in accordance with the prescribed instructions of each individual railroad and it should be the duty of each of us as supervisors to so train our men.

In closing, let me compliment you on the work you are undertaking and accomplishing, extend to you every wish for the successful administration of your association and pledge my personal support of the work that you are attempting to accomplish.

Scheduling of Locomotives for Classified Repairs

By F. B. Downey

Assistant Shop Superintendent, Chesapeake & Ohio

The scheduling of locomotives is not a recent development. For many years this has been a subject of considerable thought and many systems and procedures have been tried out. Some were abandoned as too complicated for practical use, others were improved and changed as conditions changed, but to date, no standard system is in vogue on the railroads. However, most shops where classified repairs are made, have some kind of a schedule system.

Most shops set a tentative date for the boiler test, wheeling and the out-shopping of locomotives. These dates are subject to change as shop conditions change, and the sequence of the out-shopping lineup changes accordingly, causing discord and confusion in the shops and a corresponding loss in money. All of us are familiar with the confusion when it is found that certain engines can not be out-shopped on the promised date, and with the time and money lost trying to pick up other engines in order to get the total required or promised for the month.

It is possible to set up a schedule whereby the expected output can be out-shopped without delay or changing the sequence of operations. The practicability of such a schedule has been demonstrated for several years in the shop over which I have supervision.

Planning Work Six Months Ahead

A schedule of engines to be out-shopped at this particular shop is worked up monthly, six months in advance at all times. Near the middle of each month, the schedule is gone over and a new sixth month added. Occasionally, due to a wreck or accident, important engines are damaged and can not be kept out of service to take their turn in line. In such cases, the program needs to be revised and some engine removed from the line-up or set back to make room for the more important engine. If properly handled, this need not cause undue confusion.

It is my opinion, that no backshop is too small or obsolete but that a properly set-up schedule will cut the cost of repairs and increase the output, as well as secure a better class of workmanship, due to the specialization.

A well-balanced schedule is a valuable asset to a shop with its specialized jobs. The advantage of specialized mechanics working the more important jobs has long been recognized by shop managements. The wider application of this principle has been prevented by frequent fluctuations in force and most shops limit their specialized jobs to the few more important and skilled operations. They have learned from sad experience the disadvantage of having to break in green men on such jobs, consequently they continue handling most of their work by general mechanics. We do not claim that the schedule will entirely prevent lay-off or shut-down periods, but we do know a well-planned program and a systematic schedule will reduce the frequency of such events and in almost every instance minimize its force. Thus, through a well-planned program and a well-balanced force, the schedule promotes efficiency through specialization of a far greater number of jobs than could ordinarily be handled.

How to Set Up a Schedule

How then, can a proper schedule be set up in shops where none is now in vogue? A check of the reports or repairs made to locomotives given classified repairs showing work performed, costs, man-hours and additions and betterments applied for all engines which have been overhauled over a period of several years, will set up a fairly accurate figure for the man-hours needed to give the classified repairs to any particular type of locomotive. A check of the same kind will reveal the number of man-hours available for classified repairs. Thus, if there were 25 locomotives of different types to be overhauled in a month of 25 working days and the total man hours required to out-shop these locomotives is 125,000, it would require 625 men per day. If 625 men were available daily for classified repairs, the management would know that there would be no need to increase the force to get the scheduled output.

However, it is necessary to go farther than this. A check of the same kind in each craft is necessary to determine how many machinist-, boilermaker-, blacksmith-, pipefitter-, carmen-, electrician- and painter-hours are needed for this output and then the force can be properly balanced by seeing that each department has its proper quota of men. In making the check to determine the number of men required, the more engines used of each class to arrive at an average, the closer will be your figures. On one engine using the average figure, due to extra work or lack of average work it may be found that you have too many or not enough men, but where a large number of engines are involved, the total will be surprisingly close.

Where only one type of locomotive is being repaired and all receiving the same class of work, and the same repairs to each part, a permanent schedule could be set up that would remain in effect and would only be changed as the efficiency of the shop changed, due to new practices, or new machines, and devices secured.

In most shops, numerous types of locomotives are repaired and in our shop, last year, we turned out a total of 115 locomotives for classified repairs, consisting of 21 different types and the following class of repair: 31 class 2; 50 class 3 and 24 class 4. This required close scheduling and the result was a steady flow of work to the various departments, which resulted in the locomotives being out-shopped on promised dates.

The advantages of a proper schedule are that each supervisor knows at all times, just what work is in his department, the sequence in which it is to be worked, just when it is to be completed, the number of man hours necessary to complete and the man hours available for completing same.

The outstanding feature of a schedule is that after the schedule is set up and working, a close check can be made of each gang or department, and only a sufficient number of men need be provided to maintain the schedule with no slack and no man-hours wasted.

In our shop, I conducted such a check, spending sufficient time in each gang to determine that the method of handling each job was the best that circumstances and equipment permitted, that the tools and machinery were in good shape, and that the gang or department was properly supervised. I was able by this check to remove men from several gangs or departments and use them on work which increased the output, reduced expense and greatly improved the general conditions.

Advance Material Preparations

Of important consideration with any schedule system is advance material provisions. Every shop has some system of getting material on the job, some more elaborate than others, varying from the small point that depends entirely on the stores department supplying them the moment their need arises to the more complete system of material notices given 60 to 90 days in advance of the expected shopping dates. No shop of any size can depend on the former method. Certainly a schedule could not be run on that basis. It is absolutely necessary, not only that the work be planned in advance, but the material needs be anticipated and the supply department advised in time to have the major items of material on hand when the engine is shopped.

In setting up a schedule of locomotives, the scheduling officer must be competent and know that his schedule is correct and can be completed on time. Nothing is more discouraging to the gang leader, as well as the men, than to know that the schedule is impossible and that the scheduling officer has set it up with a view of trying only to get a maximum of work out of the men and was aware that the schedule would not be met. Therefore, a schedule should be set up that is possible to be met and which at the same time, provides no slack time and will require constant and diligent effort to be made.

Records Are Important

Another item of even greater importance is a proper record system. The shop facilities on every railroad were designed to meet their individual needs and capable of restoring equipment of such class and amount as is required of the motive power department. In spite of well-laid plans of shop engineers, lack of far-sighted planning on the part of the mechanical department or unavoidable and unforeseen emergencies sometimes make it necessary to throw peak loads on the back shops. Such a situation is often the deciding factor in the purchase of some particular item of new and modern equipment but usually this is a delayed or insufficient remedy and the immediate question "What will it take to do the job?" must be answered, "So many additional man hours." The wide difference in answers under so nearly similar circumstances have often been the source of much embarrassment. The only escape from such an undesirable position is a systematic and complete record of past performance. This record should be kept on all engines that pass through the shop for repairs and should be grouped by classes of engines and class repairs.

The following is a list of the more essential items that should be kept in this record:

(1) Engine number, class repairs, date in, date out and days in shop.
(2) Cost of labor, cost of material and total cost.
(3) Shop record of man hours used by gangs and in total.
(4) Time keeping departments record of total man hours charged. (This provides a check on the accounting and will check any big mistakes on final cost figures.)
(5) Major items of work performed. (Such as flues and lagging removed; axles, cylinders, tires, crank pins, staybolts, large firebox and boiler sheets renewed or extensively repaired.)
(6) Addition and betterment charges.
(7) Totals and averages by classes at the end of every calendar year.

This may seem like too elaborate a record, but when you consider that there is no item here but that is kept somewhere in your record system in some manner and that it really only amounts to grouping the information for ready reference, you can appreciate the advantages will far exceed the bother of recapitulating your present scattered data.

After this record is set up your guess work is over. It then becomes a matter of accurate calculation in which the factor of error is surprisingly low. If for any reason the management wants to start a different type of program work, such as additional firebox installation, new tank construction or simply change over from an average run of engines to a concentration of Mallet, Mikado or some particular type of engine or class of repairs, you can tell them immediately whether it can be done or not and if not, why.

With a little experience in dealing with this system of estimating, the management will recognize its dependability and appreciate the results. You too will appreciate it as a valuable asset in checking weak spots in your organization often before anyone else is aware of its existence. It is very necessary that this background of collateral information be established in order to insure the proper functioning of the schedule system.

Supervision of the Schedule System

The actual schedule supervision can and should be done by one man, thoroughly familiar with the details of shop practice and procedure. With a satisfactory program which gives him the inshop and outshop dates, he plans every intermediate operation, plotting the work for the entire shop on a master sheet, which when finished shows the completion date of every job of sufficient importance to appear on the schedule. Approximately 125 items should provide sufficient detail. The advantage of additional items would be completely offset if it should require another man to help handle them, for the setting up of a schedule is a one-man job. One man must be able to take the program and look down through the days that it covers and visualize the whole job with its various operations interlocking with the precision of an intricate machine. Then he can lay it out on the master sheet just as the mechanical engineer plans the machine.

After the work is thoroughly planned and laid out on the master sheet, sections of this sheet, in miniature, containing all the items pertaining to each foreman's work are furnished to him. In addition to this, a shop line-up on a mimeographed form showing the due dates on 14 most important items, including engine numbers, date in, date out and class of repairs is furnished everyone interested, including mechanics on special jobs.

A check is made each day of jobs due and not done. These are posted in red ink on the master sheet and a delay report made and copies furnished the general supervisors and to each foreman to whom a delay was charged. This report is made every morning before nine o'clock which gives the supervisors time to investigate the delays and lend the necessary assistance where needed in time to prevent delaying the shop output.

This is a description of the routing procedure. In case of emergency, such as a wrecked engine or boiler defects showing up, the schedule proves of great assistance. Immediately after the need for a revision in the line-up occurs, the schedule is revised and new data furnished everyone concerned. It is evident that the fewer changes made, the smoother and more efficient will be the functioning of the shop generally; thus, the necessity for a well-planned program and a well-balanced force is obvious.

Workmen in the shop quickly grasp the working of such a plan and in most cases, prefer to work to such a plan, rather than to come into the shop not knowing what is scheduled for the day or when they will be asked to drop the job on which they are working and rush some other job in order to make up for a supervisor's mistake.

Support of Shop Organization Necessary

To successfully work a schedule such as outlined, it is necessary that the entire organization be sold on the idea and give their support. If one department fails to hold up its end or shows any lack of interest, the plan will fail, confusion will occur and the output will be delayed.

The human element enters largely in this plan and there is at times a desire by some to mark off jobs as being completed when there is still a few hours work necessary to complete them. This can not be tolerated and the shop management must insist that jobs not 100 per cent completed at the dead line be shown as such on the delay report. The delay reports or red mark sheet, as it is called, is a valuable aid to the shop superintendent, master mechanic and general foreman, and should be closely followed by them. In the gangs where delays exist, investigations should immediately be made from the following angles: To see if the gang or department is properly equipped with tools to handle the work; whether there are sufficient men; whether the delay is being caused by some other department; whether the supervision is handling the job in the best manner.

Gangs where no delays exists, should be investigated with the idea of finding out where extra man-hours or slack exists. In such case, some of the overflow from other gangs can be assigned, or possibly a man removed for other work. Where it is found that this particular gang or gangs are keeping abreast of the schedule by the close attention and diligence of the men and by first-class supervision, then is the time to pour on a little of the oil of approval. It is natural to expect and appreciate praise for a job well done.

This schedule system as now being used is not complicated and will be readily understood by any competent shop supervisor. Again to summarize, it consists of: A record of the man hours and costs on all classes of repairs to locomotives on the road; a record of the average man hours and cost of each class of repair to each type of locomotives, which guides the scheduling officer in getting the schedule for a similar repair to a similar locomotive; a daily record of the man-hours on each locomotive and a record of the total of man-hours on all engines undergoing repairs; a master sheet on which the scheduling man sets the date that each part or parts are due to be ready to apply and dates they are due to be applied; a separate schedule sheet, which goes to each gang foreman and contains only the items for which he is responsible and a red mark or delay sheet which shows jobs or parts not completed on time and the party or department responsible for the delay.

I feel that a committee from this association should be appointed to make a study of this and all other systems now in use, and set up for the benefit of others an approved shopping and scheduling system, which would help those that have none and improve those now in use.

Forgings and Their Heat Treatment

By L. B. Herfurth

Forging Supervisor, Missouri Pacific

It is estimated that the railroads consume about 20 per cent of the steel produced and that some three million tons of steel will be forged to its final form and size in railroad forge shops, during the year 1939. These figures indicate the importance of forging and heat-treating operations to the railroads.

The controlling factors entering into the production of quality forgings are, heating the steel to the forging temperature, the manipulation of the metal during the forging operation and the final heat treatment.

The initial heating of the steel is one of the most important steps in the production of quality forgings. Many failures of forgings have resulted from indifferent and improper heating.

The energy created by heat, brings about more physical changes in metals than any other known form of energy. When heat is applied to steel it expands, loses in strength, changes in color, undergoes structural changes, becomes more or less plastic, and at sufficiently high temperatures, changes from a solid to a liquid.

Rapid heating causes uneven expansion which results in the setting up of stresses that often cause internal segregation or bursts. Non-uniform heating will bring about the same defects. Over-heating, or burning, results in coarse structures which are practically impossible to correct by heat treatment. Over-heated steel will always be brittle and quite susceptible to early fatigue failure.

Most every one engaged in the heat treatment of steel recognizes the fact that if desirable results are to be obtained the steel must be heated slowly and uniformly to the desired temperature. Too often, slow and uniform heating is interpreted to mean a rate of heating consistent with production demands. This holds true especially when heating the steel for forging operations. There has been a tendency to divorce the heating for forging from other heat treating operations. The facts in the case are, "The heat treatment of steel starts with the initial heating for forging and ends with the heating and cooling of the final heat treating operation." With these facts in mind, it can readily be recognized that the control of the initial heating for forging is just as essential as the control of the heating for heat treatment.

In practically all forge shops, the skill and judgment of the heater is relied upon to properly heat the steel for forging operations. The temperature of the metal is, in most cases, judged by its color. The time consumed for heating is regulated by the capacity of the heating equipment and the time required for the blacksmith to work the heats. Under these conditions, it is not uncommon to see a billet drawn from the furnace which is over-heated on the surface and yet, when the billet is worked under the hammer the flow of the metal indicates that the center of the billet is considerably colder than the surface.

How Does Steel Heat?

To realize the full benefit of the mechanical treatment, the steel must be heated to a uniform temperature throughout its cross section. The problem is not "how fast can steel be heated," but rather, "at what rate should it be heated in order to have uniformity of temperature through the mass." This brings up the question, in what manner does steel heat? The surface of the billet absorbs heat from the hot furnace gasses and receives heat by radiation from the furnace walls. The only way that the center of the billet can get heat is by conduction from the surface. When the rate of heat ap-

plication is greater than the rate of conduction, the surface will become much hotter than the center. It is practically impossible to apply heat continuously to the surface and heat a billet uniformly. At different intervals in the heating stage, the rate of heat application should be slowed up, so that heat can diffuse to the center and equalize the temperature of the billet.

The ideal conditions under which to heat steel billets for forging operations, are to pre-heat slowly to about 1,000 deg. F., and hold at this temperature for a time sufficient to permit temperature equalization throughout the mass. Then raise the temperature gradually to 1,550 to 1,600 and soak again for temperature equalization. The final step in the heating is to heat the steel to the forging temperature at a rate sufficiently slow so to maintain uniformity of temperature throughout the section being heated.

It is difficult to set a time required for the proper heating of steel, however, the old rule of allowing one hour of heating time for each inch of diameter or thickness is not far amiss when heating large billets. The type of steel being heated, the design of the furnace and the amount of work to be done on the billet are factors which govern the heating time and the forging temperature.

Small sections can be heated at a faster rate than large ones and soft ductile steels may be heated more rapidly than the higher carbon or alloy steels. For example, the ends of one in. rounds of S. A. E. 3130 steel are heated in 12 minutes to 2,000 deg. for forging the heads of unit bolts. No failures have resulted from this rapid heating. However, it is a certainty that if larger sections of this steel were heated at this rapid rate, failures would result. In another instance an attempt was made to shorten the heating time of S. A. E. 9260 steel for forming into spring plates. The section size of the plates was 5 in. x 7 in. x 16 in. The rule is to allow five minutes heating time for each $\frac{1}{16}$ in. of thickness, or 35 minutes for a plate $\frac{7}{16}$ in. thick. The heating time was shortened to 25 minutes. After heat treatment, the hardness varied in the same plate, the plates warped more than usual and the assembled springs varied in load-carrying capacity. A check of the cause of this variation revealed that the fast non-uniform heating, for forming, resulted in stresses and a non-uniform structure which would have to be corrected by a normalizing treatment prior to heating for hardening.

Shaping the Metal

The shaping of the metal, under a hammer or press or in a forging machine die, is an operation that warrants careful consideration. The first requisite of this operation is that the forging equipment have sufficient force to penetrate to the center of the billet and work the metal in that section as well as the surface areas. Light blows or light forging equipment, works and flows the surface metal only. This causes the surface metal to creep from the center and results in segregation or a pipe in the center of the forging. This same condition also brings about non-uniformity of the grain structure due to the center of the billet not having received the proper mechanical treatment.

The forging should be shaped so that the flow lines will follow the contour of the forging. It is quite commonly known that steel is stronger in the direction of the flow lines than in transverse directions. This is exemplified by the fact that gears, having forged teeth, show greater strength and endurance than those which are machined from blanks.

The automatic shape cutting machine has been a valuable contribution to the forge shops. With the proper preparatory forging it is quite possible to produce intricate shaped forgings at a comparatively low cost. The blacksmith foreman is often tempted to eliminate the forging of the steel to the approximate shape, and cut the parts from plates, disregarding the direction of the flow lines in the metal. This practice is satisfactory for a large number of parts, but when the forging is to be subjected to impact or alternating stresses it is essential that the proper forging practices be followed.

In all probability the upset method of forging is more indifferently performed than any other method. Quite often too much metal is upset at one operation. This results in lap-overs which are a serious defect in a forging.

In other cases, the stock is doubled back and the steel is heated to the welding temperature for welding and forging in the die. This method is considered a poor practice because only one blow is required to shape the forging which is not sufficient to properly refine the grain structure. Numerous blows are more effective in refining the metal and completing the weld, than one of great force.

The design of upsetting dies should provide sufficient preliminary upsets to insure that no lap-overs, or other defects, will result in the final upset.

When high forging temperatures are employed and the forging is finished at a comparatively high temperature, the grain structure will be coarse and difficult to correct by heat treatment. On the other hand, if the forging operation is continued after the temperature of the steel has dropped to certain limits, severe stresses and internal defects are quite likely to result.

From the above it is quite evident that there is a definite range of temperature at which steel is forgable. This forging temperature range will vary with the composition of the steel. A safe maximum temperature, for the ordinary grades of forging steels is 2,100 to 2,200 deg. F. The minimum temperature, at which these steels should be forged, is 1,550 to 1,600 deg. F.

The finished non-heat-treated forging will be more or less strained, the grain structure of the steel will be distorted and elongated in the direction of the flow of the metal. Steel in this strained and unstable state is quite brittle and offers feeble resistance to fatigue. To correct this condition, the forging is subjected to some form of heat treatment.

Why Forgings Are Heat Treated

The object of heat treatment is to relieve forging strains, induce machinability, refine the grain structure and develop the properties suitable to the service conditions under which the forging is to work.

The heat treatment of metals is made possible by the structural and physical changes that metals undergo when heated to certain temperatures. The temperatures at which these changes take place are called the critical temperatures of the metal. These changes do not occur instantaneously but require time to proceed to a completion. Furthermore, the critical temperatures will vary with the composition of the steel, and, likewise some steels will have more than one critical temperature. In such a case the completion of the structural change requires that the steel be heated through a range of temperatures.

The structure existing prior to heating to temperatures above the critical range, is obliterated and a new grain structure is born. When the steel cools, from a temperature above the critical, the reverse of these changes takes place.

Broadly speaking, the heat treatment of steel is a function of temperature and time. The steel must first be properly heated to a predetermined temperature; second, it must be held at this temperature for a period of

time to permit the completion of the structural change and to establish a state of equilibrium.

Steel can exist in four different states at atmospheric temperatures. First, the natural state as it comes from the forge shop or rolling mill; second, the annealed condition; third, the fully hardened state, and fourth, the tempered or semi-hardened state.

In the first state, as forged or the natural condition, the steel will be strained, as a result of forging operations. The grain structure will be distorted and elongated in the direction of the rolling of forging. Under these conditions the steel will be more or less brittle and have feeble resistance to shock or impact. To condition the forging to meet service requirements, it must be subjected to heat treatment by one of the several processes.

Heat Treating Processes

There are four principal heat treating processes; namely, annealing, normalizing, hardening and tempering.

The full annealing operation consists of heating the steel slowly and uniformly, to a temperature some 50 deg. above the critical range and holding at this temperature for the proper saturation time. Following the heating and saturation cycle, the steel is cooled slowly, most always in the furnace.

The object of annealing is to soften the steel, increase machinability, relieve forging strains, refine the grain structure and develop maximum ductility. Steel in the annealed state is in its normal and weakest condition. It will have its minimum tensile and yield strength and its maximum ductility.

Normalizing is accomplished by heating the steel to a temperature from 75 to 100 deg. above the critical range, holding it at this temperature for a period of time, and cooling in still air. This treatment differs from annealing, principally as to the manner of cooling. In annealing the cooling is retarded to permit the steel to return to its normal state. When normalizing the cooling is accelerated. This faster cooling rate results in a finer grain structure, an increase in hardness and strength with a slight decrease in ductility.

Normalizing is quite effective in relieving forging strains and equalizing the structure, hence, it is very helpful in reducing warpage during machining and subsequent heat treating operations.

When large forgings are to be used in the normalized state, a tempering treatment follows the normalizing treatment. The tempering of normalized steels increased ductility and resistance to fatigue, at a slight sacrifice in strength.

Hardening, or quenching, as it is sometimes called, involves heating the steel to a temperature of 50 deg. above the critical and cooling very rapidly from that temperature. Most steels require quenching in a coolant, such as water or oil, to develop the fully hardened state. Steel always has a tendency to return to its normal state.

In annealing, the cooling rate is slow and there is sufficient time for the structural changes to occur and establish the normal condition. When the cooling rate is accelerated, the structural changes do not have time to proceed to a completion, therefore, the cooling rate governs the structure and properties resulting from heat treatment.

The structure of hardened or quenched steels will be much finer than that of annealed or normalized steels.

In the fully hardened state the steel will have its maximum hardness and strength, but will have little or no ductility. Steel in this highly strained, hardened state is seldom fit for any commercial use. The strains resulting from the rapid cooling are relieved and the hardness modified by tempering.

Tempering, or drawing, consists of reheating hardened, or normalized steel to some predetermined temperature below the lower end of the critical range. The primary object of tempering is to induce ductility or toughness and relieve the strains set up by the rapid cooling. This is accomplished at the sacrifice of tensile and yield strength. Some heat treaters are inclined to perform the tempering operation indifferently. This operation governs the properties developed by heat treatment, that is, the properties of hardened steel can be modified, by tempering, to meet any specifications within the characteristics of that particular steel.

Railroad Forge Shop Methods

Some of the procedures followed in the forge shops of the Missouri Pacific Railroad are briefly outlined.

Carbon vanadium steel is used for the manufacture of main and side rod forgings. The billets are moved from the storage yard to the forge shop and placed on racks beneath the doors of the billet heating furnaces. Heat, escaping from the openings around the doors, warms the billets to about 250 to 300 deg. The time of the warming up period varies from 5 to 8 hr., according to the size of the billets.

About an hour before the close of the work day, the billets are placed directly in front of the open furnace doors. Heat radiates from the furnace and preheats the billets. Just before quitting time, and after the temperature of the furnace has dropped to about 1,400 deg., the billets are charged into the furnace. They remain in the furnace and preheat by radiation of heat from the furnace walls. At 11:40 p. m. the furnace is fired. The temperature is raised slowly and at 8 a. m. the billets are at the forging temperature, 2,100 to 2,200 deg. An optical pyrometer is used to check the temperature. The heating time, not including the warming up period, is 16 hours. The furnace is an over-fired type and has four working doors.

The forging equipment consists of a 5,000-lb. steam hammer. During the forging operation, when the temperature of the billet drops to 1,600 it is reheated. Four heats are required to complete a main or intermediate rod forging.

The forgings are normalized and tempered in a car bottom over-fired type furnace, which is equipped with automatic temperature control instruments. Each forging is properly supported and raised from the hearth to permit free circulation of the hot gases.

The heating time of raising the temperature of the forging to 1,650 deg. is eight hours. The forgings are held at this temperature for eight hours and then cooled in still air, to 800 deg. or less.

The car is replaced in the furnace and the forgings are reheated to the tempering temperature, which is 1,150 to 1,200 deg. This temperature is maintained for a period of eight hours and the forgings are cooled in the furnace to 800 degrees, or less. The final cooling is in still air. This procedure has been followed since 1926. To date no failures occurring from improper heating or forging, have been reported.

S. A. E. 2115 steel is used for valve motion parts, such as eccentric rods, radius rods, combination levers, etc. This is a low carbon, medium nickel steel and is comparatively soft and ductile. The billets are not preheated but are permitted to soak in the furnace, for a reasonable length of time, before firing the furnace. During the forging operation, the workmen are watched closely to insure that this steel is not forged at temperatures below 1,550 deg. The completed forgings are given a full annealing treatment. They are heated to 1,600 to 1,625 deg. and held at this temperature for two hours. The forgings are cooled in the furnace.

Passenger car equalizers are rough forged from a low carbon steel, similar to S. A. E. 1010. The rough forgings are heated to 1,650 deg., and are cooled in the furnace to 1,100 to 1,200 deg. While at this temperature, the equalizers are cut to dimension with the automatic shape cutting machine. After cutting to shape, the equalizers are given a full annealing treatment.

Spring Shop Practice

Locomotive and coach springs are repaired and manufactured for the system, at Sedalia, Missouri. All bad order springs are shipped to this shop, are separated according to class, and stored on lift truck skid boxes. When a sufficient quantity, not less than six, of any class is accumulated, they are moved into the shop for repairs.

The bands are removed by cutting with an acetylene torch. The broken plates are removed and all plates are inspected.

The steel, S. A. E. 9260 is sheared to length cold, but it is heated to 1,650-1,700 deg. for punching the slots in the ends of the top plates.

For forming and nibbing, the steel is heated to 1,750 deg. in an over-fired type furnace, which is equipped with automatic temperature control devices. The nibbing machine is located between the furnace and the forming machine. The nib is forged in the center of the plate and then the plate is formed, on a solid type former, to the desired contour.

After the plates are cooled to 800 deg. or less, they are heated for hardening, to 1,600 deg., in a rotary hearth type furnace. A heating time of five minutes for each $\frac{1}{16}$ in. of plate thickness is used. The speed at which the hearth travels is adjusted for different plate thickness.

At the completion of the heating time, the plate has arrived at the furnace door and it is quenched in oil, which is maintained at a temperature of 150 deg. by means of thermostat control, which actuates the cooling system. The quenching tank is equipped with a conveyor. The speed of the conveyor is regulated to allow 4 minutes for a plate to pass through the quenching tank.

Immediately after hardening the plates are tempered in an electric bell type furnace. About 1,500 lb. of steel is tempered at each charge. The temperature of the charge is raised to 950 deg. in 1 to 1½ hours time. The charge is held at this temperature for 1¾ hours.

After tempering, several plates from each charge are tested for hardness. The Brinell hardness desired is 400. It varies from 388 to 415.

The assembled springs are banded in a hydraulic banding press. The capacity of the press is 75,000 lb. Each spring is given a deflection test of twice its load deflection and gaged for free height.

Several springs from each lot, are tested, in a beam type testing machine for load carrying capacity, at the load height.

The date of the manufacture or repair of the spring and the class of the spring are stamped on the band. Each spring failure is reported and a record is kept.

The use of silico manganese steel, and control of forging and heat treating operations, have brought about a remarkable reduction in spring failures.

Selecting Machinery and Tools for Locomotive Repairs

By R. P. Dollard

Shop Engineer, Chesapeake & Ohio

When repairing and maintaining locomotives innumerable units of machinery and tool equipment are required. Within this range are those used for heavy operations such as, turning, boring, grinding, milling and forging, which cost up to $50,000 a unit, and those for light, but none the less important, hand operations the cost of which is a matter of cents. An appreciation of the number and kinds of machines and tools required will, therefore, be of value when selecting equipment.

Railroad machinery and tools are generally located in one of the following classes of shops: Main shops, or shops at which the heaviest of classified locomotive repairs are performed; shops at which classified repairs are made and a large number of locomotives are maintained and despatched; engine terminals at which an occasional light locomotive classified repair is made and locomotives are maintained and dispatched, and engine terminals which only despatch locomotives.

New machinery and shop equipment will yield the greatest return on the cost in the main shop. When such a shop contains a correctly proportioned amount of machinery a new machine will be used continuously when the shop is working at full production, and if necessary it can be operated on a second and third shift.

Shops at engine terminals where light repairs are made require a complement of machinery and tools of sufficient kinds and capacities to machine and repair locomotive parts accurately, also to prevent keeping motive power equipment out of service occasionally because of the lack of machine tool or shop equipment. At these locations machine tools are rarely operated continuously and if the equipment is in condition to perform work within reasonable limits of accuracy, it will be satisfactory.

It appears, therefore, when new modern machinery or equipment is selected for purchase it should be done, as far as practicable, with the view of replacing less modern machinery installed in main or other important shops. The unit released by the new installation may be reconditioned, if necessary, and installed at a less important shop or terminal to permit the retirement of an inadequate or worn-out unit. In a number of instances this procedure resulted in maximum economy for the cost involved as well as improving the machine tool operations at more than one shop.

What Modern Machines Will Do

When consideration is first given to the selection of new equipment, all factors which determine the kind and capacity of that proposed should be looked into. Where the output of the shop is such that sufficient locomotive parts are manufactured and repaired, one specially designed or modern machine will frequently replace two standard or obsolete machines. In the machine shop, a modern automatic screw machine for stud, bushing, bolt and thimble work will replace two small lathes; a milling machine designed for machining valve motion parts and other similar work will replace two universal milling machines; a modern boring mill, on boring, turning and facing operations, will replace two lathes;

milling machines designed for driving box and shoes and wedge work will reduce the time of these operations to less than one-half of that consumed when performed on a planer. In the forge shop, forging machines and presses will take the place of two or more forges with manual operation. Shops where metal sheets and plates are worked can reduce the time of flanging and bending operations with improved bending brakes and flanging presses to less than one-half that required by hand operations.

A study of shop conditions will indicate to what extent new equipment can be used to secure the greatest amount of production and whether it may be located to serve more than one machinery group. Where a large number of units are considered, a complete detail time study of the shop operations and layouts of existing facilities with those proposed should be made to determine if the machinery re-arrangement will be balanced to produce the desired output. An analysis of this kind will properly locate the equipment in correct sequence of operations and avoid unnecessary handling of parts. This will automatically reduce labor costs.

Factors Involved in Estimates

When the decision is made as to the kind of equipment desired, prices for estimating purposes should be secured from reliable manufacturers and an estimate of the total installation cost made, to include material labor to install, shop expense, store expense, freight and contingencies. If the installation includes the retirement of an obsolete or worn out piece of equipment, this should be accounted for in the estimate so that the cost will be divided properly between that chargeable to capital investment and operating expense.

The justification of expenditures for machinery, tools and shop equipment is rightfully expected by railroad managements. Therefore, recommendations for expenditures covering new shop facilities should be accompanied with a "necessity and reason" statement showing the estimated savings. Unless equipment is required to meet a practice required by law, the annual savings to be effected by the installation should be greater than the fixed charges on the capital investment cost, which vary from 8 and 12 per cent.

When checking the annual savings and advantages to result from a project, the following should be taken into account:

(1) The annual labor savings to be effected in the production cost with the proposed equipment. This may involve full-time jobs, a saving in the time of labor that can be devoted to other productive work or a combination of both.

(2) Reduction in the annual cost of maintaining the proposed equipment as compared with that of equipment to be replaced.

(3) Annual reduction in locomotive maintenance effected by the proposed equipment in eliminating shipping parts to other points to be machined or repaired.

(4) The necessity of and advantages to be gained by having shop equipment which will allow important motive power to be repaired and returned to service in a minimum length of time.

(5) The improved quality of work that can be performed with new equipment that can not be satisfactorily done with worn-out or obsolete equipment.

(6) The elimination of safety hazards with modern equipment.

After it has been decided what kind and capacity of machinery or tools are necessary, consideration of special and desirable features of this equipment should be analyzed. These features should be incorporated in the specifications and the manufacturer, or possibly several manufacturers, offering satisfactory equipment should be recommended for consideration.

Factors in Selecting Machinery

In selecting machinery and tools the more important considerations are as follows:

(1) The equipment design should incorporate the latest features desirable for the work.

(2) Machine tools should have controls and operating levers so located as to eliminate loss of time.

(3) The machine should have such rigidity as to insure operation without chatter or vibration and be designed to produce a finished part within specified limits of accuracy and at minimum machine maintenance costs.

(4) Machine tools should have sufficient power, speed and feed range to use the latest high-speed cutting tools. Also, where the nature of the work permits, the use of tools and cutters of non-ferrous alloys and cemented carbide materials should be possible.

(5) Machinery used on operations requiring the use of cutting fluids or cooling compounds should be equipped with reservoirs, and pumps of adequate capacities. Catch pans and ways for returning the fluid to the reservoir should be of sufficient and correct design to prevent a sloppy condition around the machine.

(6) Lubricating systems on machinery should be complete for the lubrication of all moving parts. Splash or forced-feed systems should be provided for encased gearing and bearings. Oil cups or protected oil holes should be provided at points otherwise lubricated.

(7) All moving machine parts should be guarded insofar as is practicable.

(8) Material handling equipment and cranes should have a tested capacity 25 per cent greater than the rated capacity or have a factor of safety of at least five for the load-carrying members.

(9) When portable equipment, electric tools, pneumatic tools and other small tools are selected, consideration should be given to the quantity of repair parts required for maintaining them. Where an existing item has proved to be the most satisfactory obtainable, the selection of a duplicate will reduce the stocked repair parts.

(10) Before selecting machinery, tools or shop equipment, it should be known that the manufacturer is reliable; willing to correct defects of workmanship and material; that he can readily furnish necessary repair parts; that he has a service staff capable of furnishing the operating data necessary to secure the best results and that he has such standing as to assure the value of any guarantee given with the equipment when purchased.

(11) The price of machine tools and shop equipment is of importance. The unit offered at the highest price may contain features in design and construction which are not necessary or especially desirable. Another unit offered at the lowest bid may not be of the required quality or meet the specifications. Therefore, the price of machinery and tools should not become a deciding factor until the requirements and desirable features of the equipment offered have been given full consideration.

Estimated Savings Should Be Checked with the Actual

After machinery, tools and shop equipment have been provided, a check of the savings actually effected against that estimated should be made. Information developed by this check will be of value when future machinery and tools are considered and will show if methods employed in estimating are correct. One railroad made a check of 12 items recently purchased and installed at various points and the following data was developed:

Total estimated cost, 12 items	$46,300
This was divided between a capital investment charge of $34,600 and operating charge of $11,700.	
Estimated annual savings	$9,654
Estimated return on investment, per cent	27.9
Actual annual savings	$12,245
Actual return on investment, per cent	35.4

These items included a 4-in. single-head pipe threading machine, hydraulic driving spring testing machine, a 42-in. hydraulic shaper planer, a 24-in. crank shaper, a 24-in. engine lathe, a shop tractor, a platform lift truck, a triple head pipe threading machine, three 140 c. f. m. air compressors, a 4-ft. radial drill and a portable coal conveyor.

New Uses for New Tools

When studies are made in shops and engine terminals, it is possible that many uses for recently-developed time-saving equipment and tools may be found. A list of a few of these is given below:

(1) Pneumatic impact wrenches for removing and applying flexible staybolt caps and nuts to and from bolts at various locations on locomotives.

(2) Pneumatic and electric hand grinders and polishers for finishing surfaces of locomotive parts.
(3) Electric and pneumatic hand shears for cutting odd shapes in sheet metal and fitting up jackets and cylinder casings.
(4) Gasoline and electric-driven crane trucks for removing and applying heavy parts and handling material around shops and engine terminals.
(5) Pneumatic motor-driven jacks to reduce the time required for jacking locomotives and tenders in enginehouses and shops.
(6) Jib and post cranes with hoists at locations where material handling is concentrated to reduce the labor in handling, eliminate safety hazards and to avoid a loss of time in waiting on overhead traveling cranes in shops where such cranes are in use.
(7) Pneumatic-operated equipment for applying lubricating grease to locomotives to reduce the time required with hand grease guns.
(8) Portable electric and oxy-acetylene welding and cutting equipment to facilitate repairs.
(9) Expansion reamers for bringing to size bronze and non-hardened steel bushings after the bushings are pressed into valve motion and other locomotive parts.
(10) Portable electric and pneumatic drills mounted in frames and bench grinders for light work can be provided at distant locations from the other machinery to reduce time lost in handling materials to and from existing equipment.

Defects and Incorrect Applications

Small tool equipment selected for repairing and maintaining locomotives should be of a quality and design to efficiently perform the work intended. Incorrect and inferior small tools will often result in a waste in labor and material of greater value than the cost of tool. A few of the defects and misapplications commonly found are as follows:

(1) Taps, dies and chasers of inferior steel, incorrect hardening threads and flutes incorrectly cut; or finished with improper clearance. These result in an excess tool breakage, quickly dulling cutting edges and spoiled material due to either tearing the threads or the production of a thread having incorrect diameter and finish.
(2) Reamers and machine cutters of inferior material, incorrect hardening and incorrect grinding will result in an increased amount of power required to operate the machine and poorly finished or chattered surfaces.
(3) Forged and forming machine cutting tools of low-grade tool steel with rakes and clearances incorrectly designed and which are not correctly hardened, will increase the cost of machining.
(4) Wrenches of inadequate proportions, not properly heat-treated or made from unsuitable material will not give the desired service, cause a loss of time and possibly create a safety hazard.
(5) Grinding wheels of incorrect grades, grain size or material will result in burned or poorly finished surfaces, expensive wheel consumption and added power to drive the machine.
(6) Electric drills and pneumatic drills and hammers which are too light in capacity or too heavy for the assigned work will retard the production and increase labor costs.
(7) Chisels, sets, punches and other hand tools made of the wrong steel and not properly tempered will easily break or become dull and involve excessive cost.
(8) Inferior, worn and obsolete tools which are replaced by efficient tools at various points on the railroad should be shipped to the main shop tool room for repairs, or final disposition.

The most reliable method of securing small tools that meet the requirements is to prove the quality of the tool by a service test. Other methods are to consult manufacturers or their representatives when special needs or conditions arise and to keep posted on improved developments through trade and technical publications. The exchange of information on tools, jigs and fixtures with officers and supervisors of other railroads and industrial organizations is also of great value.

Discussion

In discussing the various factors involved in the selection of shop equipment a speaker laid considerable stress on the value of shop supervisors visiting the shops of other roads as well as industrial plants not associated with locomotive repair work. In this way, he said, many ideas are picked up the value of which more than offsets the expense.

Another speaker said that many shop men are inclined to direct most of their attention to the large and expensive units of equipment whereas, in the field of small tools there are many devices which will return greater savings on the investment than the larger units.

Another member brought out the fact that an adequate return on the investment is not always the most important consideration in the replacement of machine tools; that there always exists the operating necessity of good tools which will do the work with the required degree of accuracy.

Enginehouse Problems Caused by Long Runs

By F. J. Fahey

Master Mechanic, New York Central

When I received a request to prepare a paper for this meeting entitled "Enginehouse Problems Caused by Long Runs", my first thought was that they were mechanical in nature. I believe that the initial thoughts of most enginehouse supervisors would be the same. After considerable study I have come to the conclusion that long runs are but a series of short ones rolled into one, with less frequent inspections and minor repairs being made and that there are no mechanical problems that can be definitely attributed to them. The fact that more repair work is required per long run arrival than was the case when the runs were shorter does not, in itself, constitute a problem that can be charged to long runs. Our real problems are those of improving inspection and maintenance, with the ultimate goal of keeping unnecessary locomotive failures and other adverse conditions at a minimum.

Most railroads have formulated and issued instructions covering every phase of required inspections and repairs to be made at enginehouses at specific times which have become known as daily or periodical inspection requirements. These requirements have been based on experience and their purpose has been to keep locomotive performance at a high standard. If these instructions were followed, our problems would not be so burdensome. It is recognized that the failure to comply with instructions is not always the fault of the local enginehouse supervision and employees, nevertheless, if we can develop a better observance where they are at fault, we will make a marked improvement in locomotive performance and the elimination of adverse occurrences. The principal causes of failure to observe instructions are lack of knowledge of them and their application and a poor sense of responsibility on the part of the supervision and the rank and file. Since even a sense of responsibility can be instilled in an employee, we can obtain a better observance of instructions

through education. It follows logically that the education of employees is the principal problem with which we must contend, in order to obtain more successful operation of an enginehouse and the accompanying more satisfactory performance of locomotives on long runs.

As a general foreman is the key man in his organization, he must have or develop certain characteristics himself, in order to bring about an improvement in his organization, through education. Above all, he must be a leader and develop the cooperation of all employees under his supervision. He should know all rules and instructions governing his department and spend enough of his personal time with his supervision and other employees to know that they know and understand them. He should be able to stand criticism and adopt suggestions. He should personally investigate locomotive failures and other adverse happenings that occur under his supervision and, where they involve failure to observe instructions, he should consider his responsibilities the same way a school teacher must when an above-average number of pupils fail to pass their final examinations. He should recognize his responsibility in the training of supervision, mechanics, apprentices and other employees. He should be continually on the lookout for employees in his organization who have developed or are developing the necessary qualifications for accepting greater responsibilities and should not hesitate in pointing these men out to his superiors. If he has problems which he cannot solve or does not feel sure about, he should not feel that asking questions reduces the esteem that his superiors have for him, as they are as interested in properly educating him as he should be in educating his subordinates. He should realize that he cannot educate his organization if he tolerates the Walt Wyre type of supervisor in his organization who is always figuring that "she is good for one more trip."

Brief Daily Meetings Desirable

A general foreman's subordinate supervision are the men who make the wheels go round for him. The responsibility for training these men rests directly on him. Since the average subordinate supervisor is usually found fairly capable, as far as his ability to handle men and his mechanical knowledge is concerned, the problems of a general foreman with respect to them are to develop the same characteristics in each of them that he should have, to teach them to see things as he sees them and to know that they receive and understand all instructions issued from time to time by himself or the management. To accomplish this he must have daily contact with his supervision. It is agreed that it is almost impossible for a general foreman to hold lengthy meetings with his subordinate supervision daily, either during working hours or otherwise. However, it is possible to hold 15 to 20-minute meetings daily with the entire supervision on each particular trick. For instance, an office get-together can be held with the day supervision shortly after the rank and file have been assigned their initial work assignment, a meeting with the middle shift supervision prior to the beginning of their work assignment and the night trick meeting can be held at the close of their working assignment. At these meetings the progress of repair work can be discussed, schedules revised, instructions issued the previous day discussed and clarified, and all adverse happenings of the previous day delved into and preventions formulated to prevent a recurrence. The subordinate supervision should be encouraged to talk freely at such meetings for the purpose of obtaining an insight into the progress that is being made in the development of their capacity and for the purpose of obtaining an answer to a problem through the exchange of viewpoints.

Instructions Should Be Made Clear

The instilling of a proper sense of responsibility in the rank and file and the imparting of maintenance instructions to them in such a manner that they are absorbed is recognized as a difficult problem. The responsibility for so doing rests upon the shoulders of the subordinate supervision and whether or not they have the capacity for a more responsible position should depend upon what they are able to accomplish with the employees they are supervising. One thing sure is that they cannot instill a proper sense of responsibility by assuming none themselves. Still, we have an alarming number of supervisors who consider that their promotion from the ranks was the signal to lessen their sense of responsibility instead of increasing it. In the imparting of maintenance instructions to the rank and file, so there will be no likelihood of them being misunderstood, there is still nothing like giving each individual man involved or likely to be involved in a certain class of work, a copy of the instructions involved, in writing. These should be presented by the subordinate supervision to each employee individually and an acknowledgment obtained of their receipt. At the time of presenting them to the subordinate employees, the foreman should make them clearer if need be. He should point out that the failure to observe them will result in locomotive failures, which in turn drives our traffic to competitors and results in loss of work to their brother employees, will be effective at such a time. The subordinate foreman should also be required to check every repair job in the course of its progress and when completed and call their employees to task for everything done in an improper manner, in order to drive instructions home. In doing this, they should get away from well-fixed opinions, that a good mechanic always does good work and that a so-called poor mechanic will never be anything else, as no mechanic is perfect and a lot of the so-called poor mechanics only require a little corrective criticism, in the proper manner, for them to show marked improvement. The difference between a poor mechanic and a good one, in the eyes of a roundhouse foreman, is mainly in the different classes of work that can be satisfactorily performed by the individual. If only some of these so-called poor mechanics were given an opportunity to do some of the other classes of work with which they are not familiar, under competent supervision, the results will be found to be rather astounding. It is recognized that some mechanics will be lacking in intelligence and skill, but it must be admitted that there is a place even for them if we confine their work to that requiring neither characteristic.

A good many of our mechanics who lack intelligence and skill for all-around service have been inherited. They have been carried so long that we are handicapped in doing anything about their case. Their presence in our organization should teach us the lesson that when we hire off-road mechanics they should be required to show that they are capable men before the expiration of the time limit set in our agreements. We certainly should not carry them as has been the practice in the past.

Training Programs for New Men Needed

Now that business is increasing nicely and it appears that our furloughed rosters will eventually be absorbed, it would seem that this is an opportune time to mention that something should be done in the way of training additional mechanics in the enginehouses. I believe that it is a pretty well established fact that an enginehouse trained man is better suited for roundhouse work than the majority of back-shop-trained men. At enginehouses with suitable facilities we should start training additional mechanics via the helper apprentice and regular appren-

tice routes. In so doing, a general foreman should personally draw up the schedules for the helper apprentices eliminating the experience that he has obtained as a helper and concentrating on work that they have had no experience on. The general foreman should also personally see that both regular and helper apprentices obtain the experience called for in their schedules and are not kept on one class of work for a considerable length of time over their schedule, as has been the practice in the past. It would appear that it is a waste of words thus to caution a general foreman, still it has been my experience that the average roundhouse supervision are not giving sufficient thought to the fact that the apprentices of today are likely to be their headaches of tomorrow unless their training is personally supervised and follows a well defined schedule.

Discussion

In spite of the fact that Mr. Fahey dealt almost entirely with problems of personnel and supervision in presenting his paper on long runs, the members in attendance evidenced by their discussion that there were mechanical problems involved which might be charged against the extension of locomotive runs. One member asked the question, "What troubles of a mechanical nature are you now having with long runs that you didn't have with short runs?" From several persons came replies to the effect that major enginehouse troubles of today might be listed as hot driving boxes, broken pipes and creeping reverse gears. Remarks made from the floor indicated that the general opinion was that hot driving journals could be reduced to a minimum by first-class machine work and the exercise of the greatest care in the maintenance of axles and boxes. Roller bearings were mentioned as a means of eliminating hot journals.

Pipe Failures

Judging by the number of persons who took part in the discussion, it was evident that engine failures from pipe breakages are quite common. One mechanical officer expressed the opinion that pipe failures are largely due to putting up pipe work too rigidly and that the installation of flexible connections at strategic points on the locomotive had resulted in a marked reduction in failures on his road. Several other members reported that such failures had, in a large measure, been reduced by the practice of welded piping assemblies in which large sections of pipe work are fabricated without screwed connections and are removed and replaced as a unit.

Creeping Reverse Gears

The discussion concerning creeping reverse gears brought forth little beyond the evidence that most all roads have some trouble of this nature. One member did, however, offer a suggestion that the practice of putting up reach rods after the pipe work had been done often resulted in the necessity of making bends in the reach rod. He recommended a straight reach rod, applied before the pipe work was done.

Apprentice Training on the Canadian National

By A. H. Williams

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It has been the practice of the railways to train mechanics through an apprenticeship. Some railways give more attention to this work than others. In years gone by little trouble was experienced in getting trained craftsmen. The United States and Canada being new countries, many came from the British Isles and European countries to settle, and among them were many trained craftsmen. Therefore it was not necessary to give much thought to the training of apprentices. In recent years the conditions have changed. Craftsmen have ceased to come from the old lands, so that the railways in the United States and Canada must train their own craftsmen.

It is not so long ago that some people thought that a boy did not require brains to learn a trade in a railway shop. I have heard it remarked, "My boy is not getting along well in school; I intend to put him into the shop to learn a trade." Once a school-teacher asked me if we could take two boys that she had in her class into the shops. She said that they seemed to have little brains, but she thought they could learn a trade. When I was through talking with this teacher she realized better the type of boy that the railway requires for apprenticeship, and I do not think that she will ever again try to get rid of her brainless pupils by attempting to send them to the railway to learn a trade.

There never was a time when youth was better prepared from an educational standpoint than now. In the past 10 years more of the youth have remained at school for a longer time. Previously a great many left school on the completion of public school or even before that time. Jobs are not now plentiful so that a larger number remain at school rather than walk the streets, and the result is that more have a better education, which is a valuable asset when they are seeking employment. Many of the youth know that if they have a high school education their chances of getting employment are better, and they think twice before leaving school on completion of the public school course.

To fit youth into the business and industrial organizations they must be trained by these organizations. One might say that there are business courses in the schools and colleges and mechanical courses in the technical schools. We know that this is not enough as most courses cannot give sufficient training in the basic fundamentals of the business or trade. You cannot train a craftsman in six months, a year or even two years. A youth may be trained to operate a machine or perform some specific operation in the building of a machine. He is not a craftsman but a specialist in one mechanical operation.

I would like to direct my remarks more especially to the training of craftsmen for the railways. I believe that a railway should have a planned system of apprentice training. It is not necessary to have an elaborate and expensive system, but a well planned system is an asset to a railway company. In the past 10 years comparatively few apprentices have been trained by the railways. Commencing with the depression in 1929 the railways had to lay off quite a number of their craftsmen and most of the railways discontinued the training of apprentices. A few railways continued their system of apprentice training on a much reduced plan, as it was felt by the managements of these railways that it would be a

mistake to discontinue the training of apprentices altogether.

To continue a policy of not training apprentices would be a mistake and the railway company that does so may find it difficult to secured trained craftsmen for replacement, as a large number of furloughed craftsmen may not return to the service owing to their finding employment with other companies. This may be particularly true with the younger men. In the past not enough thought has been given to formulating a plan for the starting of a limited number of apprentices each year. The starting of apprentices was left to the decision of the superintendent of shops. If business was good and the shops were busy a number of apprentices would be started, usually more than could be properly trained in the shop, and often too many were brought in at one time, which often made it necessary to place them wherever they could be fitted in without much thought of the training the apprentices would get, or of what value the apprentices might be to the shop.

The officers of the Canadian National realize the importance of having a well planned system for training apprentices, so that they may have mechanics who have been trained for replacement of craftsmen in the different departments of main shops, roundhouses and repair and inspection yards. For more than 75 years apprentices have been trained on railways that are now a part of the Canadian National System.

In 1930 the management of the Canadian National decided to have a uniform policy for the training of apprentices. I shall outline to you the System of Apprentice Training on the Canadian National Railways.

Canadian National Policy

It is the policy of the Canadian National to train its own craftsmen through a standard system of apprentice training. In order that they may be retained in service as they finish their apprenticeship, only sufficient apprentices are taken on each year to take care of the normal separation from the payroll. A survey is made of the number of craftsmen in each trade who will reach the age of 65 over a period of years, at which age they are retired. A check-up is made yearly of the number of craftsmen who have been separated from the payroll during the year on account of retirements, deaths, resignations, dismissals, or promotions to assistant foremen, foremen, or any supervisory or special positions which remove them from the craftsmen's payroll and place them on monthly salaries. The survey enables the company to determine the number of apprentices to be started in any trade to take care of the separation from the payroll due to the retirement age of 65. This, together with the yearly check-up of other separations from payroll, enables the company to start apprentices to take care of their future retirements. The ratio of one apprentice to five craftsmen is never exceeded. Apprentices are credited with two years seniority on completing apprenticeship.

Headquarters Organization

The general supervisor of apprentice training, with headquarters at Montreal, part of the organization of the chief of motive power and car equipment through the shop methods department, is responsible for the general policy of apprentice training in both shop and class work over the system. He arranges the program for the starting of apprentices in the shops on the different regions. This program is worked out in conjunction with the general superintendents of motive power and car equipment of the various regions and must have the approval of the chief of motive power and car equipment. He consults with each general superintendent of motive power and car equipment regarding matters of policy of training on his region, and makes periodical trips of inspection over the system, holding meetings with the supervisor and examiner of each region, also with shop and class instructors, to discuss problems and suggestions to improve apprentice training in shop and class work. He also inspects the class work of each apprentice and the shop training affecting each apprentice. The general supervisor of apprentice training keeps an individual file of the training of each apprentice on the system, on which are placed quarterly shop reports, class work examination papers, reports of semi-annual increases. This not only gives a very complete history of the training of each apprentice, but also enables the general supervisor to maintain a personal contact with each apprentice on the system.

Monthly Reports

Monthly reports are forwarded from each region to the general supervisor of apprentice training, showing the number of apprentices in the service, number taken on each month, number completing apprenticeship and the number dismissed or resigned. A weekly report shows absentees from class and the reason for their absence. A monthly report is forwarded showing the names of apprentices changed from one machine to another or to different classes of work and the time spent in each position. When an apprentice is started, copies of all forms placing him in the service, also school reports and entrance examination papers are sent to the general supervisor of apprentice training. These forms are the beginning of the apprentice's training file.

Cost of Apprentice Training

The General Supervisor keeps a check on all costs for apprentice training, which include supervision and shop and class instruction, cost of apprentice time attending classes which are in company shop time, classroom supplies, text-books and traveling expenses. All orders for classroom supplies and text-books must be approved by the general supervisor of apprentice training.

Annual Report

A report is prepared at the end of each year covering the training of apprentices as follows:

1—Apprentices in service: Number taken on at each shop during the year, number completing apprenticeship, number retained in the service on completion of apprenticeship, number resigned from apprenticeship on account of not being suited to the trade in which apprenticed, and the number dismissed for various reasons.

2—Shop and class training: The report shows the progress made in shop and class training, and comparative marks made by each shop in subjects taught in classes, also any improvements made during the year in class and shop training.

3—Special educational work: Showing apprentices attending University in Engineering and serving their apprenticeship. Special educational visits made by apprentices to manufacturing companies and other places of interest.

4—Safety and accident prevention: Which is stressed in the training of apprentices.

5—Promotions of ex-apprentices: To supervisory positions.

6—Sports: Entered into by apprentices at different shops.

7—Cost of apprentice training.

This report is sent to the chief of motive power and car equipment, and copies to each general superintendent of motive power and car equipment.

Regional Organization

There is a supervisor and examiner of apprentices in each region, under the direction of the general superintendent of motive power and car equipment. He has supervision over the training of apprentices at main shops, enginehouses and car repair and running yards, in accordance with the standard regulations and instructions issued from time to time by the general supervisor of apprentice training through the general superintendent of motive power and car equipment. He consults and co-operates with the superintendents of shops and with the instructors in shop and class training, and renders assistance to the shop and class instructors in any way that they may require.

Examinations

The supervisor and examiner, in addition to supervising apprentice training, arranges for the examination of apprentices annually, in subjects taught in the apprentice classes, namely mathematics, drawing and trade theory. All apprentices must be examined at five different periods, at least, during apprenticeship of five years, or over the 500 hours that apprentices are allowed to attend classes on company time.

He prepares examination papers and, on the completion of the examinations, marks the papers. A report is made of the results of each apprentice examined, and the papers are forwarded, together with a copy of the results, to the general supervisor of apprentice training, and a report of the results is also sent to the general superintendent of motive power and car equipment.

Inspection of Shop and Class Training

The supervisor and examiner periodically inspects the shop training of each apprentice at main shops, enginehouses and car repair and inspection yards, and questions each apprentice so as to satisfy himself that the apprentice is getting a proper training in his particular work.

He also inspects the class work of each apprentice and questions the apprentice on the work that he has been doing in class and may question the whole class on the different subjects taught, in order to find out what progress is being made.

Report of Supervisor and Examiner

The supervisor and examiner prepares details of apprentice training in his region, at the end of each year, for the general supervisor of apprentice training, to be embodied in the annual report.

Organization of Shop and Class Work

The superintendent of shops is responsible for the training of apprentices in both shop and class work. Class and shop instructors are responsible to him for the training of apprentices and keep him informed regarding the progress of the apprentices. When an apprentice is not making sufficient progress in his shop or class training, the instructor reports the case to the shop superintendent. No disciplinary measures are taken to suspend an apprentice unless approved by the superintendent of the shop, and no apprentice may be dismissed from the service until the supervisor and examiner for the region has investigated the case and made a report to the general superintendent of motive power and car equipment. A copy of the report is sent to the shop superintendent and to the general supervisor of apprentice training. The general superintendent of motive power and car equipment must approve any report favoring the dismissal of an apprentice before such action is taken.

Application for Apprenticeship

Applications for apprenticeship are made to the superintendent of shops, or through the office of the general superintendent of motive power and car equipment, in which case they must be forwarded to the superintendent of the shop in which the applicant is to be apprenticed. All arrangements for the starting of an apprentice are made through the office of the superintendent of shops.

Great care is taken in selecting suitable applicants for apprenticeship. Applicants must be between the ages of 16 to 21 years, must be in good health and have good eyesight, that is, they must be able to work without the aid of glasses, and must have good hearing. They are required to pass a physical examination by a company doctor. Applicants must have at least finished public school (a majority of the applications accepted for apprenticeship have had from one to four years in high school or technical school). Applicants who have attended technical school usually make successful apprentices as it enables them to find the particular trade for which they are suited. A report must be submitted by each applicant showing the subjects taken in the last year in school, with the marks obtained. This report must be certified by the principal of the school. Applicants must pass an educational test, equal to a high school entrance examination, in arithmetic and composition in writing a letter of not less than 80 words.

Before an application is considered, the applicant must report to the employing officer, who is the superintendent of shops, for a personal interview.

Indenture

Apprentices entering the service are indentured to serve a five-year apprenticeship, 290 days constituting an apprenticeship year. The indenture is signed by the parent or guardian and by the employing officer for the company.

Shop Training

At each of the main shops there is an instructor who is responsible for the shop training of the apprentices in the different trades. A course of training is mapped out for each of the 11 trades in the motive power and car shops. A brief outline follows of the training given in each of the trades.

Machinist Trade.—Apprentices receive a training of 12 to 16 months on different classes of lathe work; 12 to 14 months on other machines including shapers, planers, boring mills and milling machines; 12 to 15 months on different bench and floor fitting, including training in oxyacetylene and electric welding; and 12 to 15 months on general erecting fitting on locomotives. In the last year of apprenticeship a sufficient number of machinist apprentices to take care of separation from the payroll are given nine months training in enginehouse fitting. After an apprentice has completed four years of general training, and during this training has shown special adaptability for a particular part of the trade, he may be given more advanced training in that class of work.

Boilermaker Apprentice.—Twelve months training on work including heating rivets, assisting boilermaker, sheet iron work, tender and tank construction and repairs; 12 months on ashpans, staybolts, setting and rolling of flues; 22 months on general boiler work, including six months on laying out table, and 8 months on acetylene and electric cutting and welding. During the last year a number of boilermaker apprentices are sent to the enginehouse on boiler work.

Blacksmith Apprentice.—Six months operating small steam hammer and helping blacksmith; 12 months light and medium work for locomotives and cars; six months light forging machines; 12 months general medium work, including tool, motion and spring work; eight months gas and electric welding and cutting machine; 16 months on general blacksmith work, including heavy forging work.

Pipefitter Apprentices.—Eighteen months on locomotive pipe work, including coppersmith work and general pipe work, 12 months on small copper pipes and general pipe work on locomotives, and welding; 18 months on general pipe work on freight cars and general passenger cars; 12 months on general maintenance and enginehouse work.

Electrical Apprentices.—Twelve months on shop maintenance and electrical repairs; six months on locomotive and tender wiring and headlights, 24 months general car lighting, air-conditioning batteries, Diesel engine electrical work; 12 months armature winding; six months in coach yards on car lighting and air-conditioning work.

Sheet Metal Apprentices.—Twelve months working with sheet metal worker on passenger cars; 24 months on general bench work; nine months on locomotive sheet metal work; 18 months on general passenger car work, including air-conditioning work and welding.

Carman Apprentices.—Twenty-four months on general car work, wood and steel, freight car trucks, draft gears, steel underframe construction and body steel work decking and lining; six months air brakes, including triple brakes, cleaning and testing; freight and passenger car application; six months mill machines; 24 months general passenger cars, wood and steel, including bench work, outside and inside construction and finishing, and trucks. A number of carman apprentices are sent to the running yards for 10 to 12 months in the last year of apprenticeship for training in running yard repairs and car inspection.

Painter Apprentices.—Three months in color room and paint mixing; six months freight car painting and stencilling; nine months bench work, using brush and spray gun; 12 months painting passenger cars, exteriors and interiors; 30 months' spray painting, lettering, laying out designs, stencil cutting and general painting on all classes of passenger cars.

Upholsterer Apprentices.—Six months helping upholsterers and upholstering engine cab seats; 12 months' foundation work, setting springs and building up seats; 18 months' general coach seats and cutting material and machine work; 12 months on general upholstering work; 12 months on blinds, curtains, carpets, mattresses, linoleum and rubber work.

Moulder Apprentices.—Twelve months core making; 12 months mixing sand, light machine moulding; 12 months heavy machine moulding and light floor moulding; 24 months on general floor moulding, including mixing iron and cupola practice.

Patternmaker Apprentices.—General training in all branches of patternmaking, wood and metal patterns.

The above is a general outline of the shop training. At each shop there is a more detailed schedule or chart which governs the moving of apprentices through the different branches of their respective trades.

It is essential that each apprentice secure his own tools as he progresses in the different departments of his trade. It has been necessary in some cases to keep apprentices from being moved on account of their not having the necessary tools. However, with the co-operation of the shop superintendents and departmental foremen, no difficulty is experienced in apprentices securing tools.

Safety Education

Efforts have been made to impress upon the apprentices the importance of safety. All apprentices have been supplied with copies of the company's safety rules and are examined as to their knowledge of these rules soon after entering the service. Goggles have been supplied and efforts made to see that apprentices wear clean and safe apparel.

Reports of the Progress Made in Shop Training

When an apprentice has completed the allotted time on a machine or on other work, a report is made of his progress and marks are allowed for punctuality, initiative, discipline and ability. This report is signed by the foreman of the department in which the apprentice was working and by the shop instructor. It is sent to the shop superintendent and then to the supervisor and examiner of apprentices. A copy of this report is forwarded to the general supervisor of apprentice training. The shop instructor endeavors to keep the shop superintendent informed as to the progress the apprentice is making in his trade, as a successful apprenticeship depends greatly on the support and co-operation of the shop superintendent.

Class Training

The apprentice class instructor is responsible for class instruction, the subjects taught being mathematics, mechanical drawing and trade theory. The company maintenance regulations governing shop practice are used in the teaching of trade theory. When an apprentice is working on any part of a locomotive or car, he must study the maintenance regulation governing that work. In addition to the maintenance regulations, text books are purchased from the International Correspondence Schools, and are selected from the different engineering and trade courses offered by that company.

We also stress the studying of the A.A.R. rules and safety appliances for carmen apprentices, acetylene welding and instructions on electric welding. Instruction books supplied by the railway supply companies on the following subjects are now used in the training of apprentices: superheaters, exhaust steam injectors, stokers, boosters, reverse gears, mechanical lubricators and headlight generators, and passenger-car lighting, heating and air conditioning. Arrangements are made with railway equipment companies to have their service men give lectures to apprentices on their equipment used on locomotives and cars. These lectures are beneficial to apprentices as they enable them to become familiar with the construction and repairs, so that when they are required to work on the equipment they can do so in a more intelligent way. Arrangements are also made with A.A.R. in-

spectors to give lectures to carman apprentices. These lectures give carman apprentices information that is of great assistance to them, especially in connection with yard inspection and running repairs. Lectures have also been given on air brakes, Diesel work, water conditioning and boiler construction.

Apprentices Attending Class on Company's Time

Apprentices attend class two hours each week during their apprenticeship, the total number of hours being limited to 500 during an apprenticeship. Two or three classes are held each day and the number allotted to each class is from 10 to 15 apprentices. The classes are kept down to the smallest possible number to avoid taking too many apprentices from the shop at one time. The class time is apportioned to the study of mathematics, drawing and trade theory. In the study of mathematics, an apprentice is required to make a review and is then given a test examination in order to find out in what part of the book he should start to study. This is done to prevent time being spent on a subject with which the apprentice is familiar. In the subject of drawing, most of the first year is spent on geometrical drawing and projection, then on simple mechanical drawing, the apprentices making their drawings from objects. The importance of sketching is stressed; all apprentices may not become draftsmen but they are all taught to make an intelligent working sketch. In trade theory the apprentice studies the text book that applies to the work that he is doing in the shop, i.e., when on lathe work in the shop, the text book studied in class is on lathe work. By this method the apprentice gets the theory of the work, which helps him in the practical shop work.

Quite a number of the draftsmen working in the company's drafting rooms are ex-apprentices who received their first training in drawing in the apprentice classroom.

Home Study

The railway does not believe that it is a good policy to pay an apprentice for all the time that he must spend in study. The company pays for the two hours spent in class each week, but the apprentice must spend at least two additional hours each week in home study. It is gratifying to see the interest taken in class study and the majority of apprentices spend more than two hours a week on study in their own time.

Deductions from Apprentices' Wages

Apprentices pay $10 a year for five years during the time of apprenticeship, to cover the expense of purchasing text books. This amount is deducted from the wages of apprentices, one dollar a month for ten months each year. When an apprentice completes the study of a text book, it becomes his own property, and in this way he builds up a library of his own books on trade theory, which are very useful to him for reference.

Refunds to Apprentices

As an incentive to study, 50 per cent of the money deducted from apprentices' wages is returned on the completion of apprenticeship to all apprentices making an average of 75 per cent or over in each of the three subjects, mathematics, mechanical drawing and trade theory.

Apprentice Records

Records are built up of the training of each apprentice as follows: (a) a shop progress report of the movement of each apprentice in the different departments, during the whole period of apprenticeship; (b) a copy of the form giving apprentices their semi-annual increases; (c) a record of the number of hours worked during apprenticeship. Any time lost by an apprentice on his own account must be made up before he receives his next increase in rate. Time lost due to the closing down of shops is made up at the rate payable for the last period of apprenticeship; (d) a record of all examinations in class work and the marks obtained in each examination, all examination papers being filed on the apprentice's individual file.

Individual Report of Apprentice Training

At the completion of apprenticeship, a report is made up by the supervisor and examiner of apprentices, showing the average marks made in shop training, also the average marks made in the subjects taught in class, with any special remarks about the apprentice and his training. A copy of this report is sent to the general supervisor of apprentice training and to the general superintendent of motive power and car equipment. These reports enable the company to single out the apprentices who have been outstanding throughout their apprenticeship.

When an apprentice completes his apprenticeship, he is given a certificate stating that during his apprenticeship he has received the requisite practical training and instruction necessary to qualify him to practice the said art or trade. The certificate is signed by the general supervisor of apprentice training and approved by the general superintendent of motive power and car equipment.

Apprentices Attending Universities

Arrangements can be made to allow apprentices leave of absence to attend a university during apprenticeship. Six ex-apprentices have completed a five-year university training in engineering along with their five-year apprenticeship. All six have been placed in the mechanical and electrical department. At the present time, nine apprentices are attending a university and still taking their apprenticeship training. It is found that those who take the combined apprenticeship and university training are better qualified to be advanced to supervisory positions and, no doubt, in time will make good executives.

Educational Visits

At different shops on the system, educational visits are made to manufacturing plants at the local points, or to other cities in Canada or the United States which may be visited by leaving on Friday and returning Sunday. Such visits are arranged by the instructor with the full co-operation of the superintendent of shops. The company provides transportation, but other expenses must be met by the apprentices. These visits have been of great value to the apprentices, increasing their knowledge and enlarging their viewpoints, and giving them experiences which otherwise might not have been possible.

Sports

The Canadian National encourages sports among its apprentices. At some shops, the apprentices have their own clubs, run by themselves, with the superintendents of shops and supervisors as honorary members. The shop instructors act as advisory officers. These clubs arrange sports, such as baseball, basketball, bowling and hockey, and each club arranges for an annual social evening and dance. Exchange visits are arranged between shops on the region for a game of baseball or bowling, and these visits bring the apprentices of the various shops on the region together, enabling them to get acquainted with each other.

The success and practical training of an apprentice depend greatly upon the interest taken by the shop superintendent, the general foremen and the department foreman. The time that an apprentice is under the shop or class instructor is limited, but when an apprentice is in a department he is almost constantly under the foreman of that department, and much depends upon the interest of the foreman in the training that the apprentice gets in that department, in having him placed on different classes of work in the department, apart from machine work. There is sometimes a tendency, when an apprentice is working with a craftsman to have him work in the capacity of a helper. There are craftsmen who do not want to trust him with important parts of the work. I like to see the craftsman, as the saying goes, put it up to the apprentice, not afraid to give him plenty to do. When going through one of the shops and passing beside an engine one day, I heard a craftsman say to an apprentice who was working with him, "You have as much brains as I have, and you know how this job is done. Now, you go ahead and do it." That is the attitude to take with an apprentice. These apprentices are no longer boys. They are young men, and most of them well developed and not afraid of work. As long as an apprentice is not required to do heavy lifting beyond his strength, no harm will result in keeping him busy.

There are times when an apprentice should be given the responsibility of doing jobs by himself, under the direction of the foreman. This will develop his confidence. It is only natural for the apprentice to depend on the craftsman as long as he can. I think the apprentice, during the latter years of apprenticeship, should be given a helper. There may be some who will not agree with this statement, but I know there are foremen who will. I am not advocating apprentices taking the place of craftsmen until they have finished their apprenticeship, but if you are to have apprentices trained

to take their places as craftsmen on the completion of their apprenticeship, their training must be such that they will be fitted to do so. If you do not give the apprentice the type of work he will be required to do when he goes out as a craftsman, he may make costly mistakes in learning how it is done. Is it not better to give him this training while he is in his apprenticeship and under the direction of a foreman who can guide him? I believe in giving the apprentice work that is difficult enough for him to have to use his head, to do some thinking, and also something that is worth doing. I don't mean that this should be done at first, but gradually as he advances. Very few apprentices will fail you if they understand that you trust them and have confidence in their ability. An apprenticeship can be spoiled by giving work that is too simple.

Value of Apprentice Training

Through a well-planned apprentice training system an apprentice gets a thorough training in all branches of his craft as well as a good technical training in mathematics applicable to his craft, mechanical drawing and trade theory. A good foundation is laid, upon which he may build throughout his years of experience as a craftsman.

A system of apprenticeship such as we have on the Canadian National is an asset. The railway is supplied with well-trained craftsmen and potential supervisors, who may advance to the highest offices of the mechanical department, and even to highest responsibility in the railway.

The five years that an apprentice is in training are usually between the ages of 16 and 23. This is one of the most important periods of his life, as it is in this period that a young man begins to assert himself, to act and think for himself, and to question home training and authority. Without proper guidance, it may mean disaster for him. When a young man begins an apprenticeship with the Canadian National, he is placed under the direction of men who are not only able to train him in his trade, but to give him the needed guidance and to detect in him those things which need correction. This cannot be done by driving a young fellow, but by personal contact and by winning his confidence.

I always have a feeling of regret when I have to turn away so many young men, because it is impossible to consider all who would like to be placed in the service as apprentices. I never feel that it is a waste of time to spend a few minutes talking with a young man. Although I may not be able to give him any hope of employment, yet I may be able to give him some advice, or leave a thought with him that will encourage him to go on. Is it any wonder that so many young men go wrong when they find themselves up against a stone wall, without any hope for the future? Some years ago I was on a committee to make a survey of apprentice training for the American Railway Association. When the report of the committee was submitted at a meeting of the railway association, and while it was being discussed, a railway officer got up and made this statement. "A very short time ago I was speaking to a warden of a penitentiary who said, 'very few men come to this institution who have served an apprenticeship.' Why did the warden make that statement? I think I can tell you. Statistics show that the majority of men confined in penitentiaries go there between the ages of 18 and 24 years. During those critical years, young men who have had the opportunity of serving an apprenticeship have been under training and discipline, and their minds have been well occupied with work.

The greatest asset that a country has is its youth. Youth must be educated and trained—the extent of their value, both to themselves and to their country, depends on their training. The Canadian National is making a valuable contribution to the country through its system of apprentice training. The training of mechanics through the apprentice system is twofold in its outlook. We are not only training craftsmen, but young men who are to be the citizens of our country and upon whose shoulders will rest its destiny.

Young men will copy the good that is reflected by the man with whom they come in contact, and they may also copy some things that it were better they did not. I believe that those who have anything to do with the training of apprentices should have the same interest in them as they would like other men to have in their own sons. Man is a copyist. We are the reflection of others. The only lasting monument that we can leave to posterity is what we give of ourselves, of our knowledge and of our experience, which will continue in the lives of others.

Training and Coaching Supervisors

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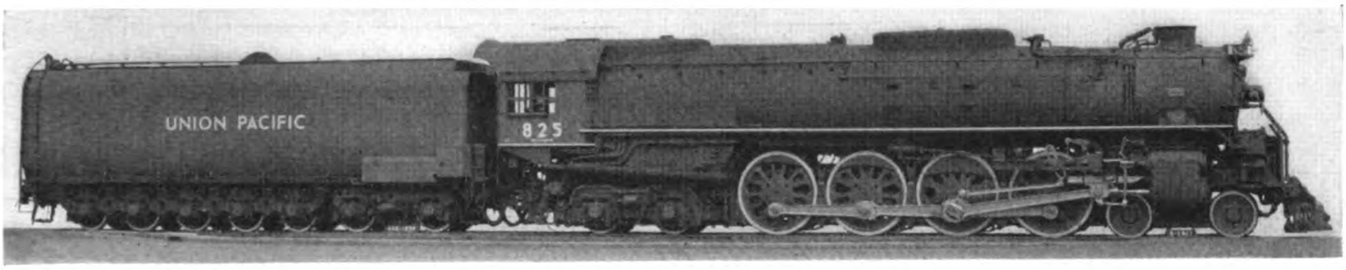
against which the railroads are suffering could and would exert a tremendous influence for good. Seeing to it that employees are properly advised and encouraged in such efforts seems to me to be a broad and important avenue for constructive coaching. Carrying on public relations campaign in the shops or, in other words, selling the railroad to all working in the shops that they may, in turn know as much of their railroad is, I realize, far afield from the old days, but we have left those behind us. We are living in a new day, a day of changes and progress and everyone must keep in step. As evidence of this one must only think back to the time before such ideas as educational training courses for apprentices was ever heard of and before training courses for supervisors had come into existence. Both have proved their value on the Missouri Pacific.

A large number of our supervisors are voluntary students in courses made possible to them; likewise apprentices. Learning from books about shop practices, about how to handle men along with work—the practical side—produces splendid results and it is not theoretical but most workable, as results have proved it helpful to the individual, to the shop and to the railroad; just as ever-increasing efficiency of America's railways has proved that we can find better ways of doing things if we but look for them. Again, co-operative working, looking through the eyes of the fellow workman—those working for them—as well as his own makes it possible for supervision to find better methods to do their work.

It is a big task, and an important one, for those in charge of the supervisors to encourage and urge continued looking to what some may call "cutting the head in"; progress has been made in this direction. It must have been if one but looks at the glorious, inspiring record of our achievement. Greater success lies ahead of us; no one who knows railroad men can doubt that.

If I have one message that I would like to leave with you today it is that you know enough about your work, about your railroad to believe in it and, in turn, sell it to your friends, to the public, and constantly insist on a fair measure of opportunity for your industry.



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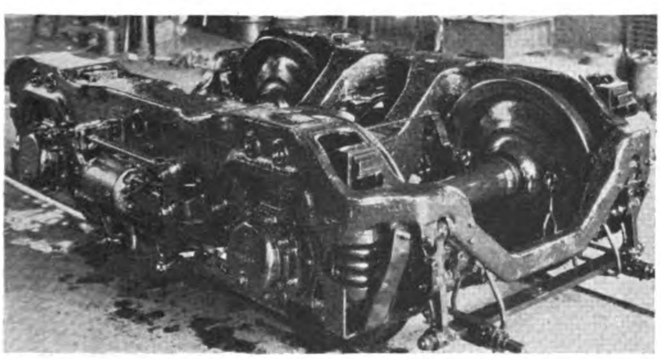
Locomotives for Union Pacific

Fifteen 4-8-4 type built by the American Locomotive Company evolve from design of those received from the same builder in 1937—Tractive force, 63,800 lb.; driving wheels, 80 in. diameter

DELIVERIES of 15 4-8-4 type high-speed freight-passenger locomotives have been made during the past two months to the Union Pacific by the American Locomotive Company. While based on the design of the 20 4-8-4 type which were built by the same company for this railroad in 1937, a comparison of the dimensions shows considerable change in detail. The cylinders of the new locomotives have been increased from 24½ in. to 25 in. in diameter, and the driving wheels from 77 in. to 80 in. in diameter. The same boiler pressure, 300 lb., has been retained. There has been no significant change in the tractive force—63,800 lb.

The Boiler

The boiler is equipped with a Type E superheater. It has 184 flues, 3¾ in. in diameter, and 50 tubes 2¼ in. in diameter, 19 ft. in length. This is 18 in. shorter than the tubes and flues in the boiler equipped with the Type A superheater on the original design. That length has been added to the combustion chamber which is now 90 in. long as compared with 72 in. on the earlier locomotives. The firebox is the same width and length. The firebox tube sheet is welded to the combustion chamber and firebox crown sheet, and the firebox door sheet is welded. Flannery flexible staybolts with welded sleeves are installed around the outside of the back head, at the top, across the corners and down the ends of the side sheets. There is a complete installation in the throat and around the combustion chamber. All crown stays are also flexibles, except the eight center longitudinal rows, and flexibles are installed in these rows for the first six transverse rows across the front of the combustion chamber. The back corners of the mud ring retain the large radius.



The four-wheel tender truck

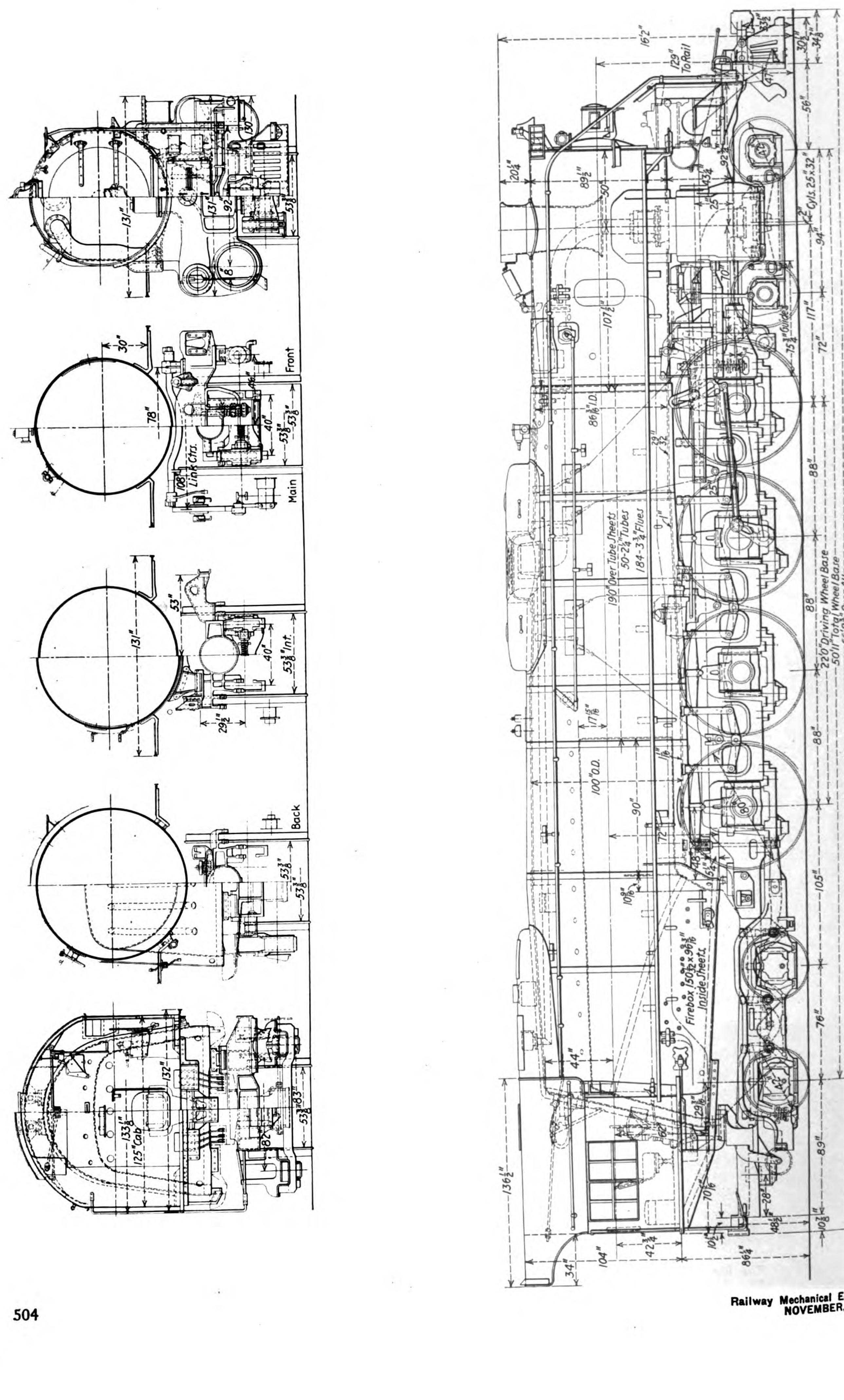
The boiler is supported on the Commonwealth bed casting by a sliding shoe, immersed in oil, which takes the place of the conventional waist sheet, and is located at the center of the boiler. In order to give added stiffness, the smokebox liner is extended upward to the center line of the boiler.

The fireboxes are fitted with Firebar grates, and Security brick arches carried on five 4-in. arch tubes. There are 12 2¼-in. combustion tubes through each side of the firebox. There is a Sellers exhaust steam injector on the left side of the locomotive and a Nathan non-lifting injector on the right side. The stoker is the Standard type BK. Wilson blow-off cocks and sludge removers are used.

The smokestack is 26½ in. in diameter at the choke and has a continuous taper from the choke to the top of the stack. The exhaust pipe is the railroad's standard multiple-jet type having four nozzles 3⅞ in. in diameter located on a circle 13 in. in diameter. All exhaust ports through the cylinder and into the exhaust pipe have been made exceptionally large. In the smokebox is the Locomotive Economizer Corporation's front-end arrangement.

The Running Gear

The engine truck on these locomotives is of the Alco design similar to those applied to the previous order, except that an improved spring suspension has been employed. Instead of the spring-borne load being carried on a single semi-elliptic spring on each side, this load is divided. Only approximately one-third is carried on the semi-elliptic spring; the other two-thirds is carried on coil springs. This has the advantage of using a much shallower semi-elliptic spring which is therefore more flexible, but the initial shocks are absorbed by the coil springs.



Cross-section and elevation of the Union Pacific 4-8-4 type freight and passenger locomotives

General Dimensions Weights and Proportions of the U. P. 4-8-4 Type Passenger and Fast-Freight Locomotives

Railroad	U. P.
Builder	Alco
Type of locomotive	4-8-4
Service	Passenger and fast freight
Dimensions:	
Height to top of stack, ft.-in.	16–2
Height to center of boiler, ft.-in.	10–9
Width overall, in.	133⅛
Cylinder centers, in.	92
Weights in working order, lb.:	
On drivers	270,000
On front truck	94,000
On trailing truck	119,000
Total engine	483,000
Tender	406,500
Wheel bases, ft.-in.:	
Driving	22–0
Engine, total	50–11
Engine and tender, total	98-5
Wheels, diameter outside tires, in.:	
Driving	80
Front truck	42
Trailing truck	42
Engine:	
Cylinders, number, diameter and stroke, in.	2–25 × 32
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7
Steam lap, in.	1⅜
Exhaust clearance, in.	¼
Lead, in.	5/16
Boiler:	
Type	Conical
Steam pressure, lb. per sq. in.	300
Diameter, first ring, inside, in.	86 3/16
Diameter, largest, outside, in.	100
Firebox, length, in.	150 1/32
Firebox, width, in.	96 3/16
Height mud ring to crown sheet, back, in.	79 15/16
Height mud ring to crown sheet, front, in.	89 15/16
Combustion chamber length, in.	90
Arch tubes, number and diameter, in.	5–4
Tubes, number and diameter, in.	50–2¼
Flues, number and diameter, in.	184-3¾
Length over tube sheets, ft.-in.	19-0
Net gas area through tubes and flues, sq. ft.	9.91
Fuel	Bituminous coal
Grate area, sq. ft.	100.2
Heating surfaces, sq. ft.:	
Firebox	442
Arch tubes	57
Firebox, total	499
Tubes and flues	3,971
Evaporative, total	4,470
Superheating	1,900
Combined evap. and superheat.	6,370
Tender:	
Style	14-wheel
Water capacity, gal.	23,500
Fuel capacity, tons, level full	25
Rated tractive force, engine, 85 per cent, lb.	63,800
Weight proportions:	
Weight on drivers ÷ weight engine, per cent	55.90
Weight on drivers ÷ tractive force	4.23
Weight of engine ÷ evap. heat. surface	108.05
Weight of engine ÷ comb. heat, surface	75.82
Boiler Proportions:	
Firebox h. s. per cent comb. h. s.	7.83
Tube-flue h. s. per cent comb. h. s.	62.34
Superheat. surface per cent comb. h. s.	29.83
Firebox h. s. ÷ grate area	4.98
Tube-flue h. s. ÷ grate area	39.63
Superheat. surface ÷ grate area	18.96
Comb. h. s. ÷ grate area	63.57
Gas area, tubes-flues, per cent of grate area	9.89
Evap. htg. surface ÷ grate area	44.61
Tractive force ÷ grate area	636.7
Tractive force ÷ evap. htg. surface	14.27
Tractive force ÷ comb. h. s.	100.2
Tractive force × dia. drivers ÷ comb. h. s.	801.3

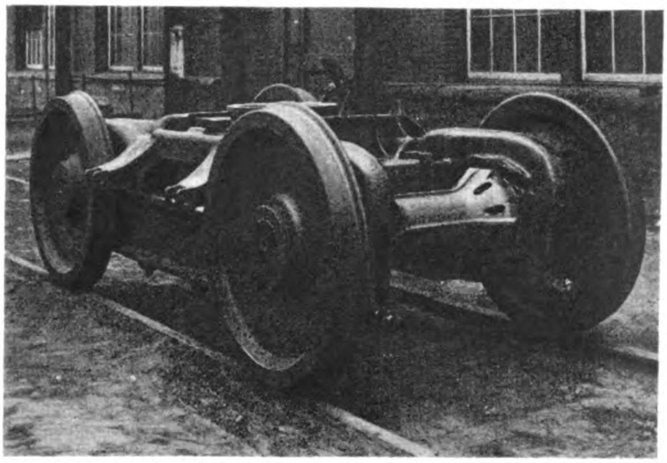
The side frames of the truck are formed with pedestals in which the roller-bearing housings fit. Between the top of the roller-bearing housings and the engine-truck frames is interposed a pad of Fabreeka for the purpose of absorbing the rail vibration before it can enter the truck side frame.

The Alco geared roller-centering device has been designed with roller surfaces machined to produce the resistance desired. The initial resistance is about 17 per cent of the spring-borne load for a distance of 1 in. each side of the center, changing at this point to 33⅓ per cent resistance and remaining at this figure throughout the range of the lateral travel.

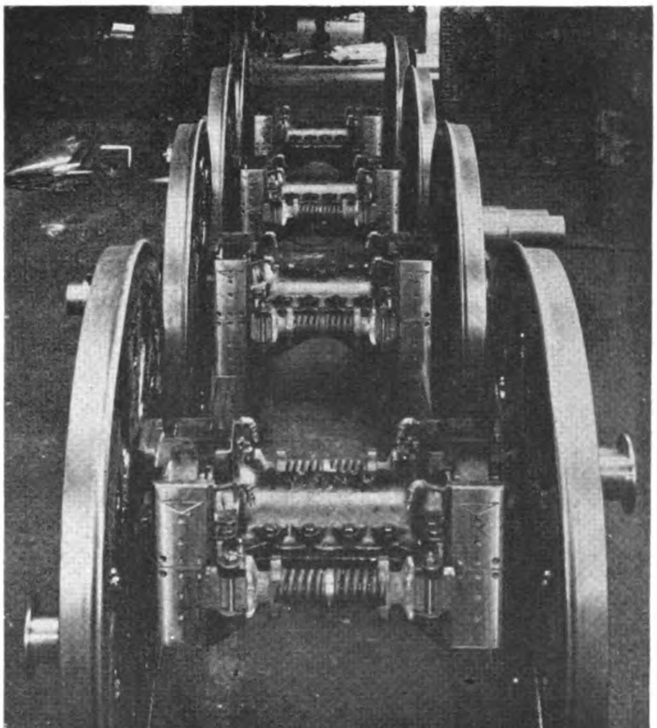
The swing frame in which the swing bolster fits is protected front and back with hardened-steel renewable wearing plates. Mechanical force-feed lubrication is provided on these sliding surfaces as well as on the center-plate bearing.

On ten of the locomotives the engine truck, the driving axles, the trailing truck, and the tender journals are all fitted with Timken roller bearings. On the other five locomotives all of these journals have SKF roller bearings. On the engine trucks of the locomotives equipped with the SKF roller bearings, the upper half of the bearing housings extends from side to side, while the lower half is simply long enough to enclose the roller bearings. The main driving-axle journals are nominally 13¾ in. and the others 12½ in. in diameter. The diameters of the engine-truck journals are 8¼ in.; of the trailing-truck journals, 8 in., and of the tender journals, 6¾ in. The driving wheels have Boxpok centers.

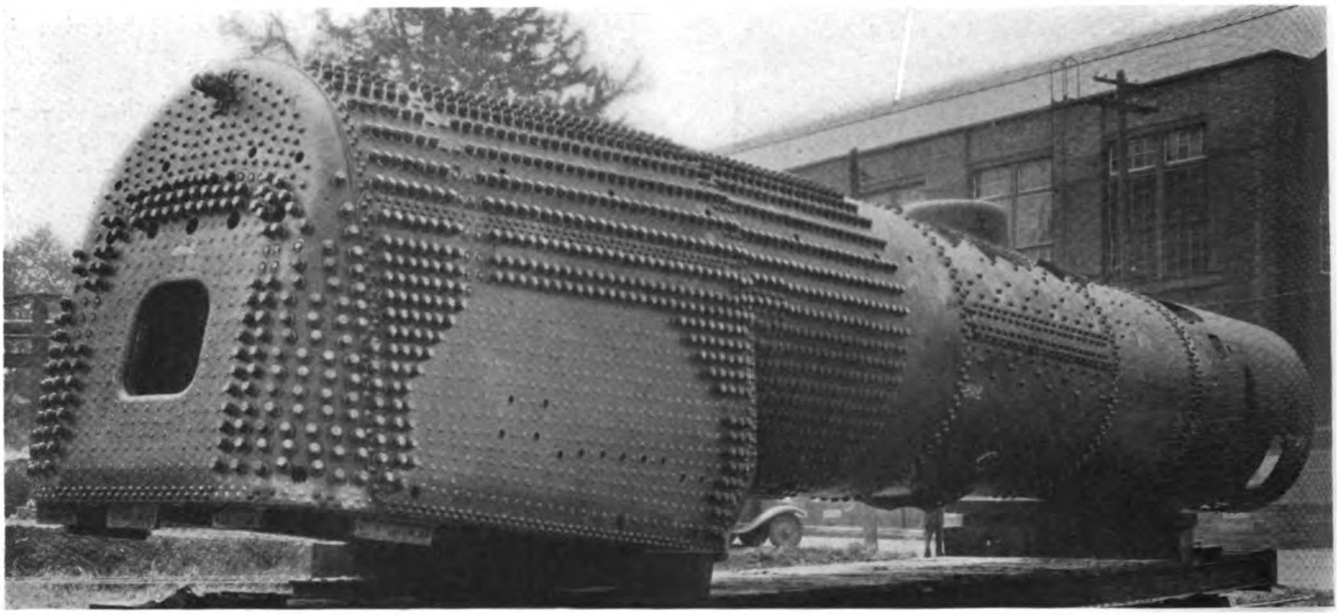
A feature of the driving-spring suspension is the use of the coil springs at the dead ends of the spring rigging. At the front end of the locomotive is a cross equalizer



Alco engine truck with a combination of coil- and elliptic-spring suspension



Alco lateral-cushioning devices applied on Timken roller-bearing driving boxes



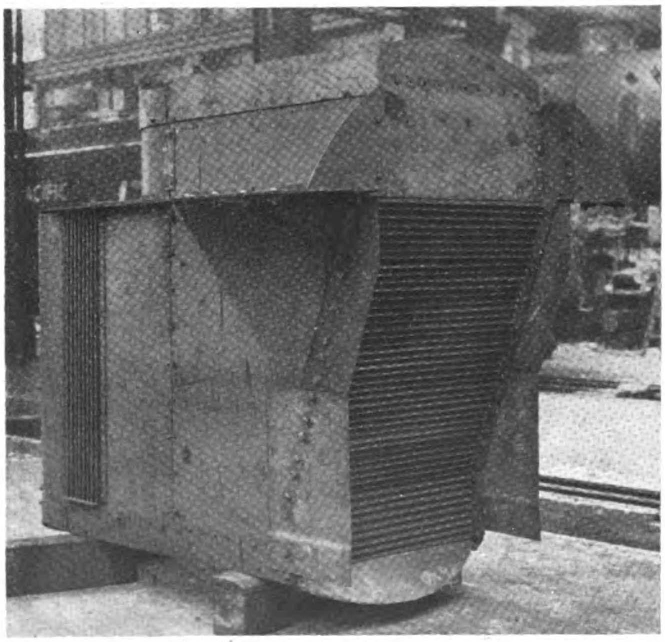
The boiler of the Union Pacific 4-8-4 type locomotives

and connected to the equalizer at points inside of the frames are spring hangers which pass through coil springs seated against the underside of the bed casting.

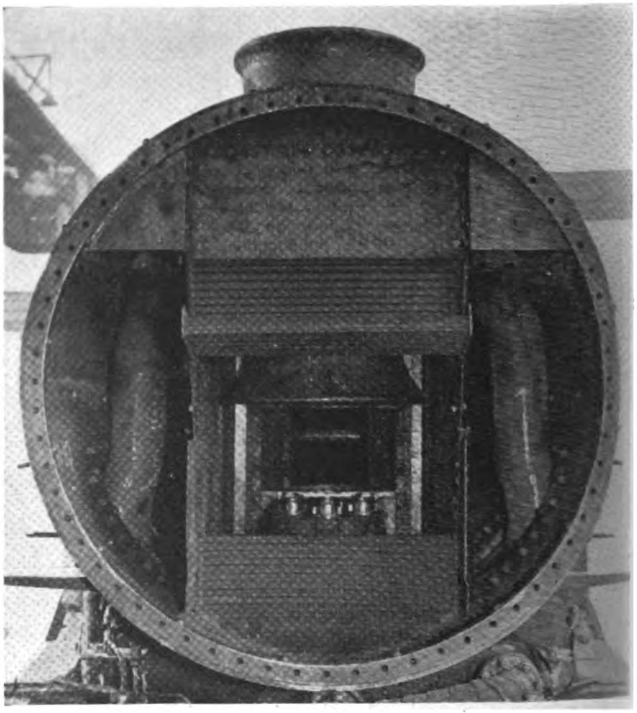
A similar cross equalizer is applied at the rear end of the back driving springs and the hangers which connect to the front ends of the trailing-truck equalizers pass through coil springs on their upper ends which are seated in this cross equalizer. The rear trailing-truck spring-hanger is also connected through a coil spring to the trailing-truck frame. The trailing truck is the Commonwealth four-wheel delta type.

Each of the driving axles, with the exception of the rear axle, is equipped with the Alco lateral-cushioning device. On the front driving axle a lateral movement of ¾ in. each side of the center is provided, and the initial lateral resistance is approximately 17 per cent of the spring-borne load, increasing at the rate of about 2,000 lb. for each ⅛ in. of travel. The cushioning devices on the second and third driving axles furnish $\frac{5}{16}$ in. lateral movement each side and have an initial lateral resistance 8 per cent of the spring-borne load, increasing at the same rate as for the front axle.

All truck wheels are rolled steel, 42 in. in diameter, the same size wheel being used on the engine truck, the trailing truck, and the tender. For ten of the locomotives they were furnished by the Carnegie-Illinois Steel Corporation; for the other five, they were furnished by the Bethlehem Steel Company.



The Locomotive Economizer Company's spark arrester ready for installation



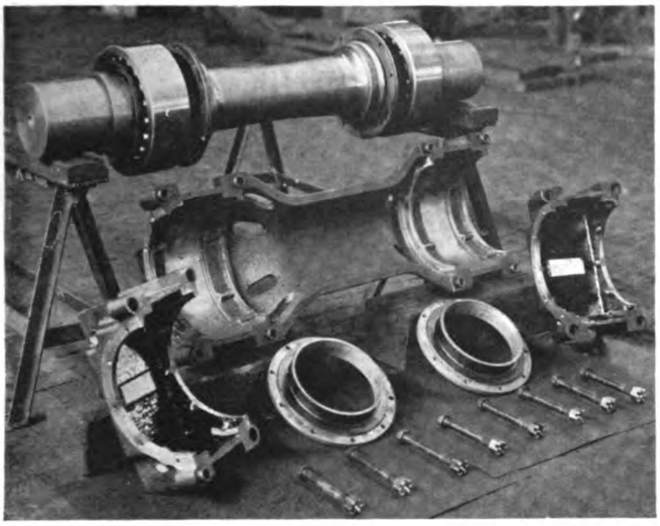
Front of the spark arrester removed to show the exhaust tips and stack extension

Pistons and Valves

The piston heads are alloy rolled steel with the Locomotive Finished Material Company combined universal

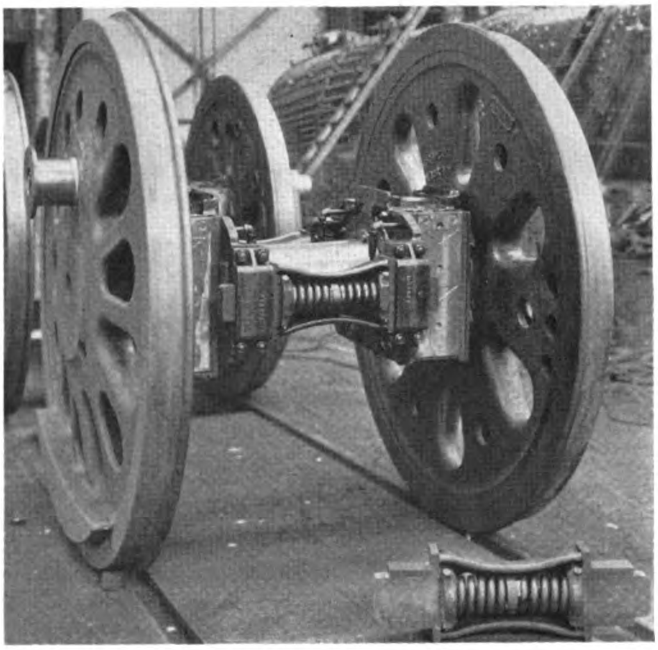
sectional type bull rings and packing rings, half bronze and half cast iron. The piston valves are the Hunt-Spiller lightweight type with Duplex sectional packing rings. Cylinder and valve bushings are also of Hunt-Spiller gun iron.

The valve motion is the Walschaert type controlled by the Franklin Type reverse gears on ten locomotives and Alco reverse gears on the other five. The maximum valve travel is 7 in. All valve-motion parts are fitted with the McGill type needle bearing, as is also the front end of the eccentric rod. The back end of the eccentric rod has an SKF self-aligning type bearing.



Disassembled bearing housings of an engine-truck axle fitted with SKF roller bearings

Valve-motion parts have Alemite fittings for soft-grease lubrication. Mechanical lubrication takes care of the steam chest, cylinder barrels, stoker engine, throttle, driving-box pedestal faces, driving-box automatic wedges, trailing-truck pedestal faces, guides, radial buffer, reverse gear, engine-truck center plate, and trailing-truck center plate.

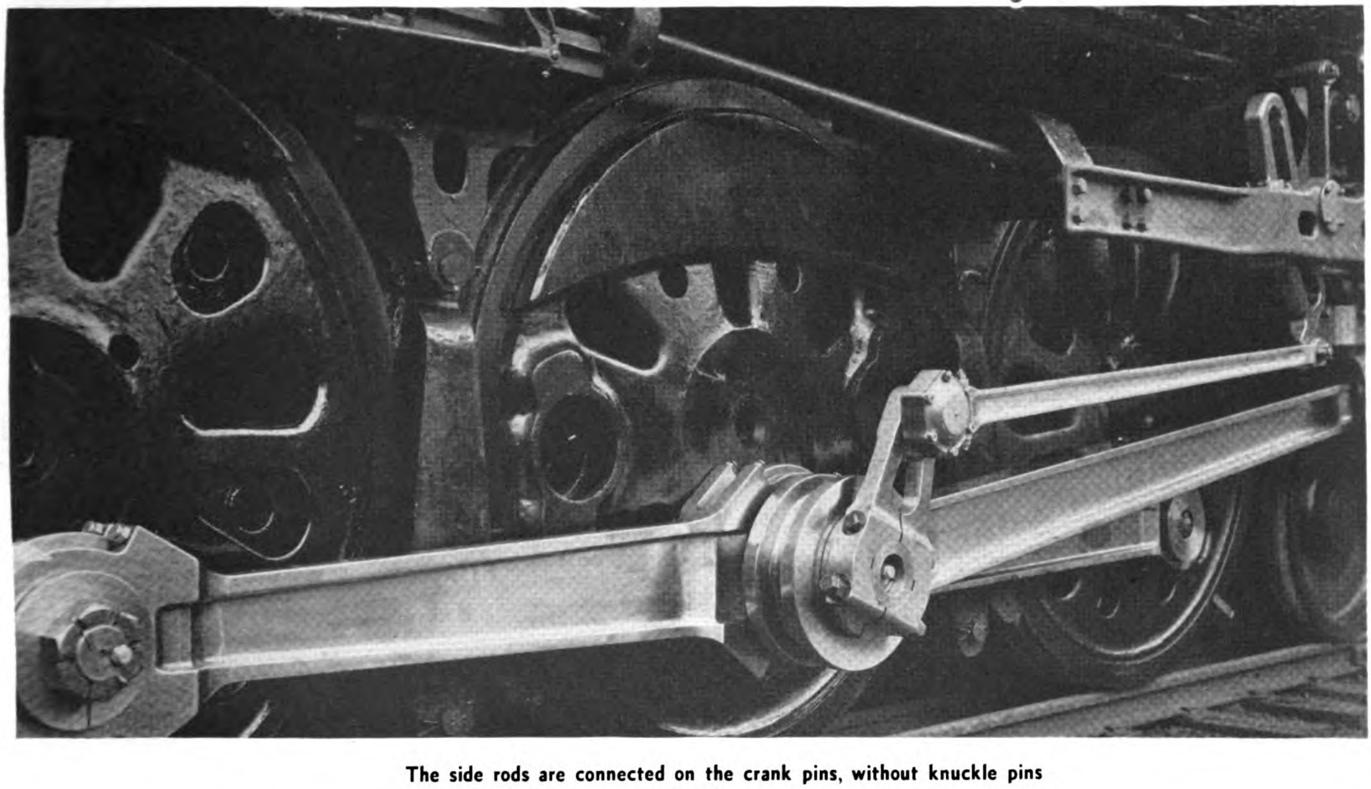


The lateral cushioning device installed on SKF driving boxes

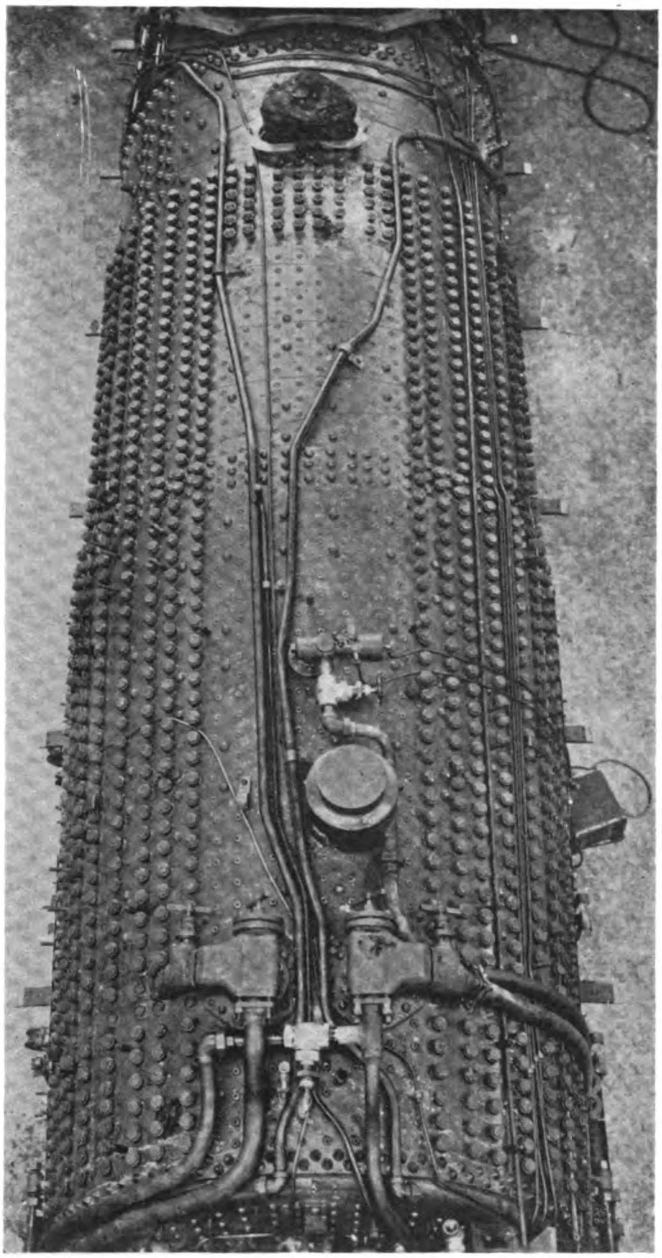
The cab is entirely supported from the boiler, which eliminates the relative movement between the two as the boiler expands and contracts. It is also equipped with the railroad's vestibule curtain arrangement. Between the engine and tender is a Franklin radial buffer.

The tender is a new type of exceptional design and capacity. It has a four-wheel leading truck followed by ten wheels in pedestals, all equipped with roller bearings. It has a cast-steel water-bottom frame with integral cast-in pedestals.

The five pedestal wheels on each side of the tender

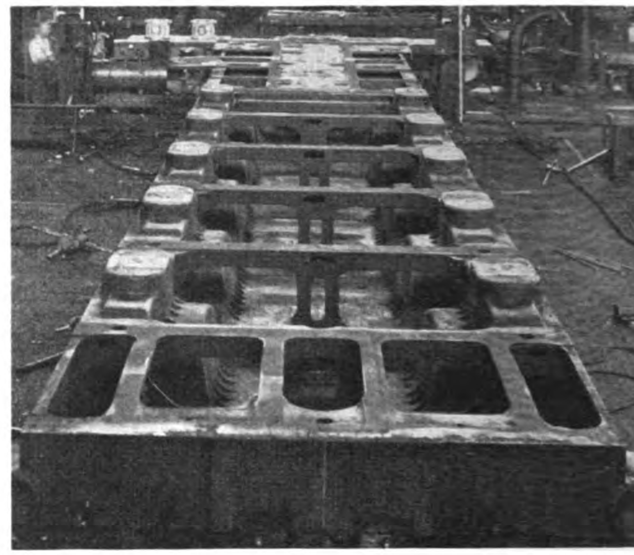


The side rods are connected on the crank pins, without knuckle pins

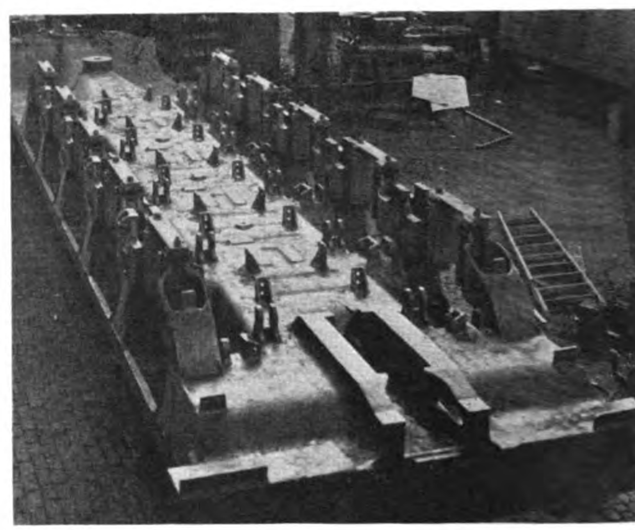


The top of the boiler over the firebox and combustion chamber

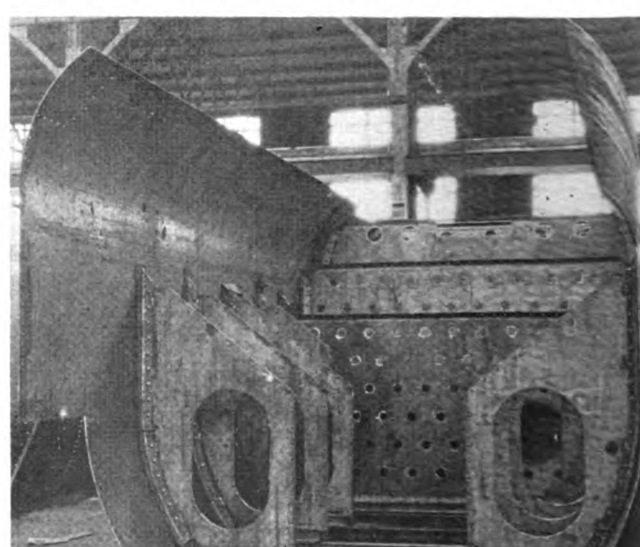
The cab is supported directly on the mud ring and the side of the firebox wrapper sheet



Looking into the rear of the tender water-bottom underframe



The pedestals are an integral part of the tender underframe



Interior of the tender tank before the application of the coal-pit plates

are equalized together, with one semi-elliptic spring and two coil springs over each box. The front and back end of each set of equalization is attached to the frame through a cushioning coil spring. Between each box and the semi-elliptic spring saddle is a Blunt centering device to resist lateral movement. On the front and back axles this resistance is 17 per cent, and on the intermediate axles it is 8 per cent. The Blunt centering device is made up of an upper and lower seat with three intermediate rollers which are engaged by means of gear teeth to the upper and lower seats to insure positive and simultaneous rotation. Each pedestal liner is made up of two hardened spring-steel plates between which is bonded ½ in. of laminated rubber. A total lateral play of 1¼ in. is provided on each side of axles Nos. 3, 4, 5 and 6, and ¾ in. on each side of axle No. 7.

Comparison of Principal Data for Union Pacific 4-8-4 Type Passenger and Fast Freight Locomotives

Date built	1937	1939
Builder	American Loco. Co.	American Loco. Co.
No. built	20	15
Rated tractive force, engine, lb.	63,600	63,800
Weights in working order, lb.:		
On drivers	270,000	270,000
On front truck	81,200	94,000
On trailing truck	113,800	119,000
Total engine	465,000	483,000
Tender	366,500	406,500
Wheel bases, ft.-in.:		
Driving	21—6	22—0
Engine total	49—3	50—11
Engine and tender total	97—6	98—5
Driving wheels, diameter outside tires, in.	77	80
Cylinders, number, diameter and stroke, in.	2—24½ x 32	2—25 x 32
Heating surfaces, sq. ft.:		
Firebox	422	422
Arch tubes	57	57
Firebox, total	479	499
Tubes and flues	4,118	3,971
Evaporat. htg. surface, total	4,597	4,470
Superheat. htg. surface	1,473	1,900
Combined evap. and superheat.	6,070	6,370
Tender:		
Style	12-wheel	14-wheel
Water capacity, gal.	20,000	23,500
Fuel capacity, tons, level full	25	25

The tender leading truck is the General Steel Castings Corporation four-wheel equalized type with a roller centering device providing for 17 per cent initial and 33 per cent constant resistance.

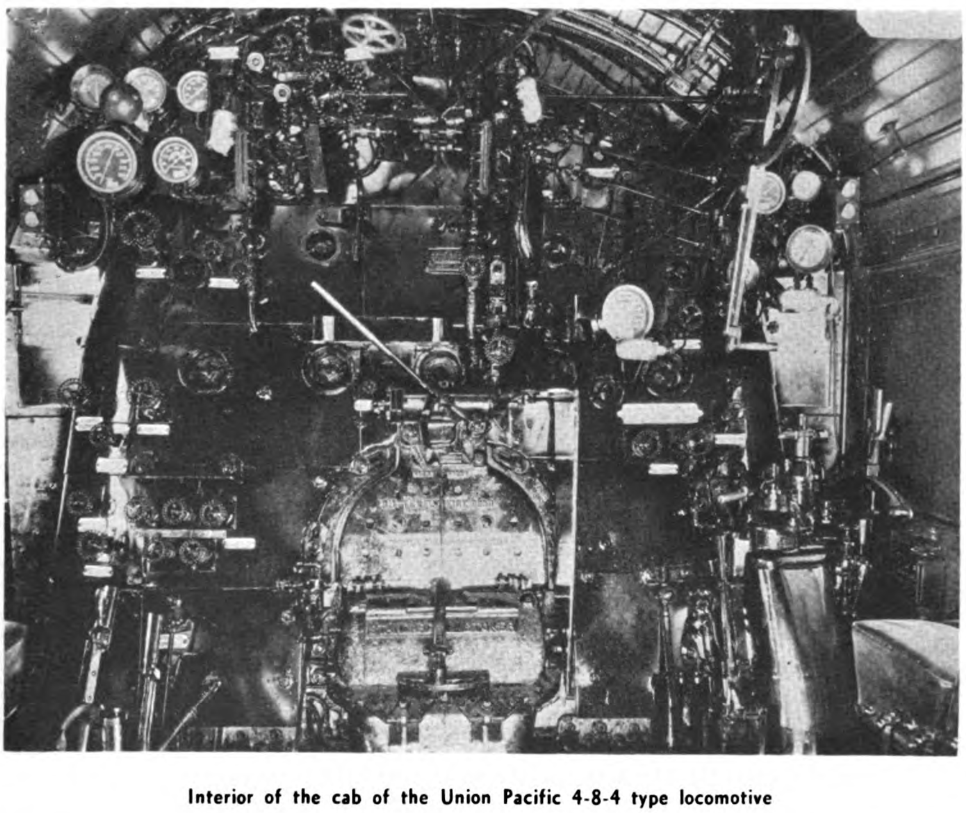
There are clasp brakes on all tender wheels. The truck construction is regular, but there is an individual brake cylinder for each pair of pedestal wheels.

There is no brake on the engine truck, but provision has been made for future application. The drivers do not have clasp brakes, but use extra long brake heads to which two brake shoes are attached. The trailing truck is equipped with clasp brakes. The air brakes are New York No. 8 ET with two 8½-in. cross-compound compressors.

Locomotives Assigned to Heavy Passenger Service

It was one of the 1937 order of 20 4-8-4 type locomotives built for the Union Pacific by the American Locomotive Company which attained the highest speed in the A. A. R. tests when it handled a 16-car, 1,000-ton train westbound to Grand Island at a maximum speed of 89 miles an hour and, eastbound, on a slightly descending grade, at 102 miles an hour.

The new locomotives will operate in pool between Omaha, Neb.; Cheyenne, Wyo.; Denver, Colo.; Ogden and Salt Lake City, Utah, and Huntington, Ore. The longest through runs are between Omaha and Ogden, 990 miles; Omaha and Salt Lake City, 1,026 miles, and Omaha and Huntington, 1,394 miles. The locomotives will be used largely in conventional passenger-train service. The ruling grade, westbound, in this territory is 1.55 per cent and, eastbound, 1.14 per cent. The locomotives are capable of operating continuously under maximum horsepower output at 90 miles an hour. Calculations were based on 110 miles an hour design speed with 100 miles an hour operating speed. The locomotives will negotiate curves of 20 deg.



Interior of the cab of the Union Pacific 4-8-4 type locomotive

EDITORIALS

Why Attend Conventions?

One of the principal industries of America is said to be holding conventions. There are few fields of activity which are not served by an association. In most cases these organizations spring into being almost spontaneously as the leaders in the field realize the need for concerted attack on its common problems.

Membership in most, although not all, of these organizations is purely voluntary. Some of them carry on activities which extend considerably beyond the holding of meetings. The meeting, however, is the medium through which the greater part of their objectives are attained. In the railroad field, attendance at such meetings is usually justified by their inspirational and educational value. Addresses of railway officers are almost always inspirational and frequently of definitely informative value. Committee reports and papers tend to clarify the thinking of all who listen to them and participate in their discussion. Improvements in practice are disseminated much more rapidly than would be possible without the mass contact of those responsible for results from their practical application on the various railroads. Not only is the meeting itself of value in this respect, but considerable store is placed upon the value of the smaller group discussions which develop outside the meeting room.

These advantages of convention attendance have been restated frequently and their validity is quite generally accepted. There is, however, another reason for attendance at conventions and for becoming active in the work of the association in one's field of activity, particularly of those associations in which membership is entirely voluntary. This is the value of association activities in the development of men. One may seem to be adequate in the discharge of his immediate responsibilities and yet never fully develop qualities of independent leadership. To sit through a convention discussion of an acute common problem gives each man a measure of the quality of his own views in relation to those of others of like responsibility. Not only are one's views modified and clarified, but a degree of self confidence is engendered in men possessing any degree of leadership ability which stimulates independent thinking when they get back on the job.

There are executives who are not altogether favorable toward the development of qualities of independence in their subordinates. Such qualities disturb the quiet acquiescence in rules and standards of practice handed down from the top. A man who attends conventions and learns to defend his own views against the world is not likely to acquiesce silently in a rule or method which he believes can be improved. The greater his qualities of leadership and the stronger his character, the more persistent is likely to be his fight for change.

Discipline is an extremely essential quality in a railway organization just as it is in a military organization. One of the qualities which has distinguished the American soldier from others, however, is the degree to which he exercises his own intelligence, in his adherence to discipline and obedience to orders. This same American quality of independence has been invaluable in the development of railway transportation. Some of the recent difficulties of the industry spring from the gradual tendency toward its suppression. The new competitive situation to which the railroads must adjust themselves, and under which they will have to live from now on, demands that this hardening of the arteries be checked and cured.

The good of the industry demands that executives should support—or at least should not directly discourage—the activities of the several voluntary associations of supervisors who come together with the welfare of the railroads at heart as well as for mutual and personal self development. The railroads need men in all positions of responsibility who can stand on their own feet and fight persistently for what they believe to be sound policies and sound methods.

Off the Record

Certain unofficial aspects of conventions have come in for a good deal of criticism in the past. This is particularly true of some of the private-room entertainment of railroad men by supply men. Such relationships are not to be condemned in themselves. Lack of self control engendered by entertainment of this kind which interferes with the serious purpose of the meetings, however, has done the cause of these associations a great deal of harm.

These meetings present a valuable opportunity to the railway supply field. The ability to contact many users or prospective customers of one's wares at one time and place provides the opportunity for both effective and economical sales effort. It should, therefore, be very much to the interests of the railway supply industry to exercise that degree of responsible control in its relations with railway men at these meetings which will keep the entire institution of associations and conventions in high repute with railway executives.

As far as the railway executives themselves are con-

cerned, they have at times undoubtedly given too much weight to instances of overt lack of self control which were the exception rather than the rule of conduct at these meetings. Such instances cannot help but weaken the standing of the individuals involved. They do not offer valid grounds for the indiscriminate condemnation of associations and convention attendance, however. To hold that they do is to imply that, on the whole, the members of these organizations are incapable of assuming responsibility for their own conduct and that they cannot be trusted to work for the best interests of the industry they serve.

The recent conventions of the four associations of mechanical supervisors at Chicago have a particularly clean record in this respect. Not only was there apparent a keen sense of responsibility in the matter of attending sessions, but wherever groups of men gathered about the hotel during the course of the conventions, the same evidence of a sense of responsibility prevailed.

This comment is inspired by the hope that it may end the use of an obsolete argument against wholeheartedly supporting the work of these organizations.

Impressions of the Car Officers' Meeting

One of the interesting features of the annual meeting of the Car Department Officers' Association, held at Chicago last month and reported elsewhere in this issue, was the support it received from railway executive officers, including such men as F. G. Gurley, vice-president, Atchison, Topeka & Santa Fe. Mr. Gurley said in effect that the association deserves every possible support because of its objectives and the important part its members play in efficient railroad operation and also because it discusses pertinent problems with a frankness and fearlessness unexcelled by any other organization.

The joint session address by L. W. Baldwin, just preceding the car officers' individual meeting, discussed "Training and Coaching Supervision" and was, of course, very encouraging and stimulating. Some interesting facts were developed in the report of the Publicity Committee which addressed a letter to a number of representative car men throughout the country asking for a frank expression of opinion regarding the potential usefulness of the Car Department Officers' Association, and what steps should be taken to assure that it will achieve maximum effectiveness.

One car department superintendent said "In my opinion, an organization of this nature is of vital importance to the railroads and I think the association should be perpetuated. One of the most important things I feel to insure its continued success is the selection of suitable officers, whereby we may have full assurance that all recommendations developed on car matters are basically sound and practical." Another master car builder said "It is my opinion that the Car Department Officers' Association should be perpetuated. Many things are taking place in the car building art and free discussion of pertinent subjects often brings out some interesting points. Aside from car construction and maintenance discussion, it seems to me that we should give serious thought to young men coming up in the ranks. These men must be encouraged and the association may wish to give this subject consideration for its next meeting."

Training of Employees Needs Attention

In connection with the subject of employee training and the development of supervisors in the car department, one of the speakers at the meeting said that, as in every great industry, questions involving the human element constitute the most important factor in practically all car-department problems. He referred to the fact that other large industries have made special studies of psychology as influencing every phase of their operation and raised the question if railroads have utilized this highly specialized experience and information to the fullest extent practicable. Apparently they have not, for with few exceptions, railroad managements have failed to organize strong personnel departments designed to give supervisors, including those in the car department, the kind of assistance needed in their important work. Since dealing with the human element is a real problem which receives little official recognition, the thought was advanced and favorably received, that a strong committee of the Car Department Officers' Association might well be appointed and asked to make specific recommendations on this subject in a report at the next meeting.

In a program as well filled with interesting addresses and constructive committee reports as that of the car officers' meeting, it is difficult, and perhaps hardly fair, to say which reports may be considered the more important. The following, however, were so outstanding as to deserve special mention: Shop Operation Facilities and Tools, Passenger-Train-Car Terminal Handling, Freight-Car Inspection and Preparation for Commodity Loading, and Equipment Painting.

With a total attendance of over 300, and in view of the general interest displayed, the association should feel encouraged to increase its activities during the coming year. Doubtless, new subjects will be suggested from time to time for the consideration of the association and one of these, not presented this year, is the question of maintaining air-brake equipment to meet the demands of modern high-speed train operation. With the former Air Brake Association not actively functioning, it would seem logical that operating problems associated with the use of air brakes should be considered by the Railway Fuel and Traveling Engineers' Association, whereas problems involved in the inspection and shop repairs of all air-brake equipment used on cars, particularly methods of repairs,

would come logically within the scope of the Car Department Officers' Association.

Problems of car shop production, machine equipment, scheduling of work and training personnel are obviously within the field of investigation covered by the Car Department Officers' Association, which is confronted with a definite challenge to develop constructive information on all of these subjects. The association will need no other press agent and no more persuasive advocate in justifying its existence to railroad managements than a set of constructive committee reports which contain so much timely and vital information that they are kept and constantly referred to when printed in the annual proceedings of the association.

The Art of Leadership

So far as the mechanical details of their activities are concerned, the members of the four railway associations which held their conventions at the Hotel Sherman, Chicago, last month, have little in common except that they are associated with the mechanical department. One golden strand, however, is woven through the substantial homespun fabric of all of their tasks. A golden thread, because it is the most valuable and the most vital, although it is to be feared that it is often over-shadowed by the multiplicity of other plain threads which, in the sight of those without perception and vision, appear to dominate and control the pattern.

That the golden thread in the programs was so pronounced this year is partly due to those who built the program of the Locomotive Maintenance Officers' Association. It was that group which persuaded L. W. Baldwin, chief executive officer of the Missouri Pacific Lines, to talk to them about the training and coaching of supervisors. The other organizations, when they learned of this, insisted that so rare a treat should be shared by all of them; and Mr. Baldwin was the honor guest at the great joint opening meeting of the five groups, including the Allied Railway Supply Association. And it is well that he should be, since he is one of the few chief executives who have been persistent in insisting on the importance of the human element in the organization and its proper supervision.

Mr. Baldwin is an engineer by training and from his performance, at least, a believer in the more modern definition of engineering: "Engineering is the science of controlling the forces and of utilizing the materials of nature *for the benefit of man, and the art of organizing the human activities in connection therewith.*"

"Organizing the human activities" in industry or on the railroads is indeed an art, and one which should be mastered by every supervisor, from the gang boss to the top executive. That this has not been very well done in the past is responsible for many needless misunderstandings in industry and on the railroads, which have cost this nation and its workers billions of dollars. Resort to force in adjusting labor difficulties —and it has not been done away with by any means— is just as useless and just as wasteful as is war between nations.

But why refer to the extremes? The little and seemingly unimportant difficulties and misunderstandings which occur in every department, every day, in the aggregate are a source of great waste and lowering of efficiency. A little haziness as to just what is expected from the worker will dull his enthusiasm about the job. Little unintentional and thoughtless actions and attitudes on the part of the boss may cause discouragement and resentment. These and many other things are due to lack of adequate coaching and instruction, and all tend to slow down production and lower the standards of the output. Well trained supervision offers the great opportunity for increasing the efficiency of railroad operation and maintenance.

The golden thread supplied by Mr. Baldwin was supplemented in various ways in the programs of all four associations, either by design or by spontaneity of expression. In the Locomotive Maintenance Officers' Association, for instance, another executive, Trustee Frederic E. Lyford, of the New York, Ontario & Western, picked up the thread and wove it even more intimately into the pattern in his discussion on "What I Expect of My Supervisors, and Why?" His message was driven home by a statement that "good equipment is fine, but good men are better—you can do a lot with good men and poor equipment, but not much with good equipment and poor men."

Learn to Compose Internal Differences

America, by sane and peaceful methods, must set an example to the warring nations of the world as to how their differences may be composed in an orderly fashion, without destruction and waste. We cannot do this successfully unless we first learn how to compose our own internal differences. In spite of our shortcomings it must be admitted that, considering the fact that the mass production era only started in this country after the beginning of the century, we have made very considerable progress in improving human relations in industry. The leaders who have pioneered in this respect have developed what can well be designated as the science of industrial supervision. The principles are well known, if one cares to take the time to master them. A great forward step will be taken when we recognize more generally the fact that successful supervision is an art. Fundamentally, it is based on an understanding of human nature and the application of the Golden Rule.

In a real sense, therefore, industry in solving its human relations problem—and it has made substantial progress in this respect in this country—is helping to supply the answer to the solution of international relationships, since that, too, is primarily a human relations problem.

THE READER'S PAGE

Deflection Under Load

To the Editor:

The editorial "Deflection Under Load," appearing in the June *Railway Mechanical Engineer* is very well written and clearly points out the well-known fact to designing engineers that tensile strength has practically no relation to the stiffness of steel as the modulus of elasticity is almost constant for a given section of steel regardless of its tensile or strength properties.

I think the last paragraph of the editorial is very pertinent and it is approaching a tragedy in passenger-car design for the future for the A. A. R. to adopt a recommended specification for passenger cars which has so little relation to the actual design and ultimate strength requirements. To add weight to the underframe promiscuously can, as a whole, produce a weak structure and particularly create a car having considerable deflection, making it hard to keep partitions and other inside finish in proper alinement and free from noise or squeaking.

A specification as important as for a passenger car should not, and in fact cannot be developed in a few weeks time. To approach an ideal passenger-car construction, considerable more attention will have to be given to the sides and particularly the roof construction of the car. To many designers the roof construction is equally as important as the underframe construction. If the two are carefully balanced and properly designed, and advantage is taken of skin stresses as in airplane design, a passenger-car structure can be produced approaching present general over-all dimensions with very little deflection, or at least a deflection which is entirely within the safe and practical limits.

K. F. Nystrom,
Mechanical assistant to chief operating officer, Chicago, Milwaukee, St. Paul & Pacific.

Worn Rod Bushings Are Still Serviceable

To the Editor:

Quite often a substantial saving in repair expense may be made, particularly in a small shop, by saving rod bushings that are smaller in bore than the pin sizes for certain pins and larger in outside diameter than certain standard rod eye sizes. It doesn't take much time to check these old bushings in order to determine whether or not they may be made use of. By saving old bushings that meet the requirements as to measurement I have several times been able to renew nearly a whole set of rod bushings without ordering more than one or two new ones from the storehouse.

The same thing is true of the split bushings as of solid ones. In the case of back-end strap brasses and middle connection brasses it is quite often that only one half of a pair of brasses need be scrapped so that where an engine comes in with half of a brass broken an old half brass can be used to make up the pair. What has been said above also may apply to floating bushings.

W. E. Howard

Detecting a Worn-Through Chill

To the Editor:

A letter appeared recently in the pages of *Railway Mechanical Engineer* concerning the detection of worn-through chill spots in wheels by color. The inference in the letter was to the effect that the Wheel and Axle Manual makes no reference to color as a method of detecting worn-through chill. Paragraph 102, page 115, of the Wheel and Axle Manual reads, in part, as follows: "When the chilled metal, or white iron, is worn through, the soft grey iron is exposed and flattened out."

It appears to me that this is a very direct reference to color determination for this defect.

Reader

Piston Rod and Wrist Pin Failures

To the Editor:

The locomotive designer, by using a high factor of safety, makes allowances for the unusual loads the piston rods and the wrist pins must carry due to water in the cylinders, excessive compression pressures, and lost motion between the crosshead and guides. Failures of these parts can seldom be laid to lack of judgment on the part of the designer.

The breaking of piston rods just inside the tapered fit in the crosshead, to my mind, is caused by excessive driving of the piston-rod key which stretches the metal, leaves a permanent set, and produces a possible fracture. Piston-rod keys do not get loose unless the tapered fit has been disturbed and, therefore, the fit should be examined when the key is found to be loose. When it becomes necessary to disconnect the piston rod from the crosshead, care should be taken to scribe a mark on the piston-rod key before it is driven out and good judgment should be used in driving the key to the same mark when it is again applied.

The breaking of wrist pins can also be charged to metal stretch. If a wrist pin is a poor fit, then trying to keep it tight by using a box wrench and a sledge hammer is apt to cause these pins to fracture at the throat fillet or in the threads. Again, when a castle nut is applied to the wrist pin and tightened but is not in the right position to line up with the cotter-pin hole, then a few more blows with the sledge on the wrench to turn the nut to the proper position may also cause a fracture of the pin.

To save a lot of damage the mechanic should have in mind the power of the screw and wedge.

W. W. Edgar

High Spots in

Railway Affairs . . .

Railroad Earnings Picking Up

The net income after fixed charges of the Class I railroads in August was $10,053,000. This compares with a net deficit of $1,181,000 in August of last year. While this, of course, is a source of gratification, the fact must not be overlooked that these earnings were very small compared with the railroad investment, and also that there was a net deficit after fixed charges for the eight months of this year amounting to over $74,000,000. Business prospects are good, but the railroads have a long way to go before they can face the future with confidence.

Building Up Railway Forces

Railway employment climbed to 1,019,063 in mid-September and undoubtedly, with increased business and more intensive activities in taking up deferred maintenance, it will continue on its way upward. This was an increase of 5.77 per cent over the same time last year. The maintenance of equipment and stores forces were up 9.98 per cent, the maintenance of way and structures forces 6.2 per cent, and the train and engine services group 3.8 per cent over last year. There was a reduction in only one of the classifications, that including executives, officials and staff assistants, which was off 0.41 per cent.

In Time of War

The railroads and mass transportation are essential in times of national emergency and particularly in case of war. Serious mistakes were made in the use of the railways by the government in the first World War. Let us devoutly hope we will not be drawn into the present conflict. In case we are, however, the railroads, the Army and the Navy are prepared to make the best possible use of that form of transportation. In the first place, the practices in handling freight traffic by the railroads have been almost revolutionized in the past two decades and we can make very much better use of the equipment today than during the first World War. In the second place, much of the trouble in the first World War was caused by the unintelligent exercise of priorities and the piling up of loaded cars at shipping ports, where they were used for storage purposes over considerable periods, rather than being promptly unloaded. With such handicaps removed, little fear need be had of a breakdown of the railroads, if the equipment is maintained in good condition and ample additions are made to it in the coming months.

Rebuilding Passenger Traffic

For a full decade, 1924-33, railway passenger traffic declined in this country. Since 1934, however, it has increased consistently. Why? Very largely because of the courage and initiative of those roads which have installed high speed, streamlined passenger equipment and which have modernized their passenger services. In commemoration of this achievement the Railway Age published a Passenger Progress Number on October 14. In the five years, 1934-38, inclusive, an annual average of 34,171,771 more passengers have used railway trains for each year.

Back-Breaking Burden

The Class I railroads in the calendar year 1938 paid 9.5 cents in taxes for each dollar of operating revenue. This included federal, state and local taxation, which amounted to 40.41 cents out of every dollar of net earnings. This at least partially explains why so many railroads find themselves in financial difficulties. The Administration and Congress don't seem to be showing any very great concern over the welfare of this backbone of our transportation system, which is regarded as absolutely indispensable and vital in times of national emergency.

Higher Speeds Not Detrimental to Safety

In speaking before the Steam Railroad Section of the National Safety Congress at Atlantic City on October 19, M. J. Gormley, executive assistant, Association of American Railroads, made the following significant statement: "In 1923 there were 31 fatal and non-fatal injuries to employees on duty for each million man-hours worked. In 1938 there were less than 7 casualties per million man-hours. * * * * It is significant that this improvement in employee safety took place during the period of greatest relative increases in average speed and average load of trains. In the freight service, average speed of freight trains between terminals increased 52 per cent from 1923 to 1938, and the average number of cars per train increased 21 per cent. During this same period of years, the casualty rate of road freight train and engine service employees was reduced 64 per cent for each million man-hours worked. In the passenger service, trains were also speeded up, new light-weight trains of streamlined design were introduced, and the standard of the service was generally raised. Road train and engine service employees in passenger service were 66 per cent safer in 1938 than in 1923. In yard service, train and engine employees were 72 per cent safer." Mr. Gormley also drew attention to the fact that there was a decline of 86 per cent in casualty frequency in the maintenance of equipment group in 1938, as compared to 1923.

New York World's Fair Railroad Exhibit

While the railroad exhibit at the New York World's Fair was not publicized nearly so effectively as that of the General Motors across the way, it proved to be one of the best drawing cards on the grounds. The Eastern Presidents' Conference, which sponsored the exhibit, held a meeting in New York on October 19, on which occasion it was decided to take the same space, 17½ acres, next year.

Good Record in Reducing Fire Losses

One of the great wastes in this country is that caused by fire. The railroads have made a determined effort to reduce these losses on their properties and with excellent results, although they still amount to a considerable sum. For the calendar year 1938, 4,372 fires resulted in a loss of $3,820,214. Smoking was the cause of 331 fires, with a loss of $320,878. Locomotive sparks and hot coals accounted for 288 fires, with a loss of $163,732. A loss of $499,874 resulted from 1,036 fires which occurred in box cars. It is interesting to compare the loss in 1938 with the average per year for the past 20 years of 6,820 fires and loss of $6,184,735. The record for the past six years has been particularly good, the average loss amounting to only $3,638,323 a year. The excellent work that has been done can readily be seen by comparing this with the average of $9,324,753 for the six years 1919-24, at the beginning of the 20-year period.

Among the Clubs and Associations

CENTRAL RAILWAY CLUB OF BUFFALO.—Meeting November 9. Speaker: T. V. Buckwalter, vice-president, The Timken Roller Bearing Company. Subject: Steam Locomotive Slipping Tests.

NEW ENGLAND RAILROAD CLUB.—Meeting November 14, Hotel Touraine, Boston, Mass. Dinner 6:30 p. m. Speaker, E. H. Roy, general superintendent motive power, Seaboard Air Line. Subject: Diesel Locomotive Application—S. A. L.

TORONTO RAILWAY CLUB.—Meeting 7:45 p. m., November 20, Royal York Hotel, Toronto, Ont. Speaker: Harry Thomason, Canadian Westinghouse Company. Subject: Electric Welding and Shop Practice.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—Meeting November 21, 8 p. m., Hotel DeSoto, St. Louis, Mo. Speaker: S. O. Taylor, master car builder, Missouri Pacific. Subject: Training of Supervision.

NORTHWEST CAR MEN'S ASSOCIATION.—Meeting November 6. Speaker: H. L. Heater, vice-president in charge of engineering, American Steel Foundries. Subject: Freight-Car Truck Design and Construction.

CANADIAN RAILWAY CLUB.—Meeting November 13, 8:15 p. m., Rose Room, Windsor Hotel, Montreal, Que. Speaker: Burt Anderson, general sales manager, Union Switch & Signal Company. Subject: Operation of Trains by Centralized Traffic Control. Moving pictures.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—At the annual meeting of the Car Foremen's Association of Chicago, held at the La Salle Hotel, on October 7, the following officers were elected for the ensuing year: President, W. J. Healion, superintendent, North American Car Corporation, Blue Island, Ill.; first vice-president, C. A. Erickson, general A. A. R. inspector, Chicago & North Western, Chicago; second vice-president, W. A. Emerson, general master car builder, Elgin, Joliet & Eastern, Joliet, Ill.; treasurer, C. J. Nelson, superintendent of interchange, The Chicago Car Interchange Bureau, Chicago; secretary, Geo. K. Oliver, assistant passenger car foreman, Baltimore & Ohio Chicago Terminal, Chicago. ¶ By virtue of his election to the presidency, Mr. Healion becomes chairman of the Board of Directors. The only other change in the board was the replacement of Mr. Emerson, who was elected vice-president, by Phil Baker, master mechanic, Belt Railway Company of Chicago, Chicago.

A. S. M. E., METROPOLITAN SECTION.—High-Speed Lightweight Trains will be the subject of a paper which will be presented by C. T. Ripley, chief engineer, Technical Board, Wrought Steel Wheel Industry, at a meeting of the Metropolitan Section of the American Society of Mechanical Engineers which will be held at the Engineering Societies building, 29 West Thirty-Ninth street, New York, on Tuesday evening, November 21, at 7:30 p. m. Mr. Ripley's paper was prepared as the American contribution to the railway session of the British-American Engineering Congress which would have been held at New York early in September had it not been for the war developments in Europe which led to the cancellation of the congress. It deals with the development of lightweight passenger rolling stock and even more extensively with motive-power developments and their implications. Roy V. Wright, editor, *Railway Mechanical Engineer,* will be chairman of the meeting.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The following new officers for 1940 have been elected by a letter ballot of the entire organization of 15,000: President, W. H. McBryde, consulting engineer, San Francisco, Calif.; vice-presidents, K. H. Condit, executive assistant to the president, National Industrial Conference Board, New York; Francis Hodgkinson, retired consulting mechanical engineer, Westinghouse Electric & Manufacturing Co., New York; J. C. Hunsaker, aeronautical engineer, Cambridge, Mass., and K. M. Irwin, assistant to vice-president, Philadelphia Electric Company, Philadelphia, Pa. Managers, J. W. Eshelman, sales engineer, Birmingham, Ala.; Linn Helander, professor of mechanical engineering, Kansas State College, Manhattan, Kansas; and G. T. Shoemaker, president, United Light & Power Service Company, Chicago.

NORTHWEST CARMEN'S ASSOCIATION.—At the annual meeting of the Northwest Carmen's Association, held at the North Central Club, St. Paul, Minn., on October 2, an unusually large and representative group of members was present to listen to the committee reports, enjoy the clever and extensive entertainment program provided and elect officers for the ensuing year. A total of 433 members and guests of the association registered for the meeting and much pleasure was expressed at the secretary's report of 161 new members since the September meeting and the treasurer's statement of a cash balance on October 1, 1939, of over $1,400. ¶ The report of the Nominating Committee was accepted and, by a single unanimous ballot, the following officers were elected for next year: President, F. M. Washburn, car foreman, C. M. St. P. & P., Minneapolis, Minn.; first vice-president, J. M. Ryan, master car builder, C. St. P. M. & O., Hudson, Wis.; second vice-president, G. A. Thomson, car foreman, N. P., St. Paul, Minn.; third vice-president, L. R. Kassick, general foreman freight cars, M. St. P. & S. S. M., Minneapolis, Minn.; secretary, E. M. Myers, chief interchange inspector, Minnesota Transfer, St. Paul, Minn.; treasurer, G. R. Johnson, chief clerk to master car builder, N. P., St. Paul, Minn.

P. & S. Division Selects Committees

FOLLOWING a recent meeting of its general committee, the Purchasing and Stores division, A. A. R., of which A. C. Mann, vice-president, Illinois Central, is chairman, has announced the subjects to be studied by committees this year and the personnel of each committee. Seventeen committees have been assigned to prepare reports. An advisory committee, consisting of the past chairmen of the Division, has been reappointed, with E. A. Clifford, general purchasing agent, C. & N. W., as chairman, a special purchasing committee has been reappointed, with L. L. White, vice-president, Erie, as chairman, and the committees in charge of regional meetings have been reorganized. The subject committees are as follows:

Purchasing and Stores Manual: P. L. Grammer, assistant purchasing agent, Penna., chairman.

Material Classification: E. G. Roberts, general storekeeper, C. R. I. & P., chairman.

Railroad Scrap: R. E. Hamilton, supervisor reclamation, C. & O., chairman.

General Reclamation (Joint with Mechanical and Engineering Divisions): E. R. Casey, superintendent of reclamation, Union Pacific, chairman.

Material Records—Pricing-Inventory: C. K. Reasor, assistant manager of stores, Erie, chairman.

Forest Products: J. E. McNelley, chief tie and lumber supervisor, A. C. L., chairman.

Fuel: P. A. Hollar, fuel purchasing agent, Penna., chairman.

Purchasing Department Practices: W. A. Clem, purchasing agent, Reading, chairman.

Stationery and Printing: B. B. Melgaard, assistant to purchasing agent, C. M., St. P. & P., chairman.

Handling Facilities: W. F. Redman, traveling storekeeper, C. & N. W., chairman.

Simplification and Standardization: A. G. Follette, general material supervisor, Penna., chairman.

Supplies for Dining Cars: J. F. McAlpine, assistant purchasing agent, C. B. & Q., chairman.

Engineering Materials: G. D. Tombs, division storekeeper, I. C., chairman.

Standard Packages: F. S. Austin, assistant purchasing agent, N. Y. C., chairman.

Stores Practices and Records: J. S. Genther, general storekeeper, L. & N. F., chairman.

Marking Tools, Materials, Etc.: W. H. Lloyd, division storekeeper, C. R. I. & P., chairman.

Loss and Damage: J. T. Kelly, general storekeeper, C. M., St. P. & P., chairman.

Regional Committees: Purchasing. Eastern—C. C. Warne, purchasing agent, N. Y. C.;

Southern—H. E. Warren, manager purchases and stores, G. M. & N.; Western—W. W. Kelly, general purchasing agent, A. T. & S. F.; Southwestern—J. H. Lauderdale, general purchasing agent, Mo. Pac.; Far Western—G. M. Betterton, purchasing agent, S. P. *Stores.* Eastern—W. R. Culver, superintendent of stores, C. & O.; Southern—C. H. Murrin, general storekeeper, L. & N.; Western—J. T. Kelly, general storekeeper, C. M., St. P. & P.; Southwestern—C. L. Wakeman, general storekeeper, Wabash; Far Western—U. K. Hall, general storekeeper, Union Pacific.

Sixtieth Annual A.S.M.E. Meeting To Be Held at Philadelphia

THE usefulness of the mechanical-engineering profession is to be stressed at the sixtieth annual meeting of the American Society of Mechanical Engineers to be held at the Bellevue-Stratford Hotel, Philadelphia, Pa., December 4-8. This meeting at Philadelphia will be the first annual gathering of the society to be conducted outside of New York City since 1890 and the first national meeting in Philadelphia since 1887. Ninety-seven papers will be presented at the 33 technical sessions. Of particular interest to railroad men will be the following:

Monday, December 4

8 p. m.

MACHINE SHOP PRACTICE

A New Method of Machine-Tool Spindle Analysis, by Thomas Barish

Machine Design and Motion Economy—Building Motion Economy into Machine Tools, by O. W. Habel and G. G. Kearful

Tuesday, December 5

9 a. m.

FUELS

Which Fuel to Choose? by G. A. Anbro

Modern Methods of Fuel Purchasing, by R. G. Rincliffe

2:30 p. m.

FUELS

Characteristics of Cloth Filters on Coal-Dust Air Mixtures, by A. R. Mumford, A. A. Markson, and T. Ravese

Defining Equitable Limits of Dust Emmission from Stacks, by P. H. Hardie

Wednesday, December 6

9:30 a. m.

EDUCATION AND TRAINING

Education and Training of Apprentices for the Aeronautical Industry, by Victor W. Page

Apprentice Training, by Ray E. Ellis

Apprenticeship in the Machine-Tool Industry, by Elmer H. Neff

LUBRICATION (I)

The Influence of Crystal Size on the Wear Properties of High-Lead Bearing Metal, by John R. Connelly

Temperature Distribution in Bearings, by E. S. Pearce

2:30 p. m.

LUBRICATION (II)

Boundary Film Investigation, by S. J. Needs

Properties and Performance of Plastic Bearing Materials, by L. M. Tichvinsky

6:30 p. m.

Banquet and Honors

Thursday, December 7

9:30 a. m.

RAILROAD

Railway-Car Engineering, by D. S. Ellis

Whip Stress in a Locomotive Main-Rod at 100 M. P. H., by M. W. Davidson (by title)

Progress in Railway Mechanical Engineering, 1938-1939

MECHANICAL SPRINGS

Calculation of the Elastic Curve of a Helical Compression Spring, by H. C. Keysor

Helix Warping in Helical Compression Springs, by D. H. Pletta and F. J. Maher

Progress Report—Fatigue Tests of Helical Compression Springs at Wright Field, by C. T. Edgerton

Progress Report on Book on Strength of Metals, by D. J. McAdam, Jr.

THERMODYNAMICS

A Rational Representation of the Flow Performance of Reaction Steam-Turbine Blading, by Adolf Egli

The Viscosity of Superheated Steam, by G. A. Hawkins, H. L. Solberg, and A. A. Potter

Report on Change of Enthalpy of Steam with Pressure at Low Temperatures, by F. G. Keyes

2:30 p. m.

STEAM GENERATORS

Steam Boiler Performance and a Method of Comparison, by E. G. Bailey

The Locomotive Boiler, by C. A. Brandt

New Coordination Committee for Mechanical Associations

FOLLOWING the close of the meetings of the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association, the Master Boiler Makers' Association, and the Locomotive Maintenance Officers' Association at Chicago on October 19, the Committee on Coordination of Conventions was reorganized. Under the chairmanship of Frank Roesch, vice-president, Standard Stoker Company, this committee has long been active in promoting the present arrangement of simultaneous meetings, with a combined exhibit when one is held. Following the recommendation of its chairman, Mr. Roesch, in his report before the joint session of the four associations, that the committee be discharged and a new committee organized to carry on the arrangements for the coordinated meetings, the old committee has been discontinued and a new Committee of the Coordinated Associations takes its place. This committee, of which the president and secretary of each of the associations are members, elects its own officers. Frank Roesch was reelected chairman and T. Duff Smith, secretary-treasurer of the Railway Fuel and Traveling Engineers' Association, was elected secretary. In addition to the four railway associations, the Allied Railway Supply Association is represented on the committee. Included in its duties are convention and exhibit arrangements. It is also available to serve as a coordinating agency to avoid conflicts in the programs of the four associations.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—R. P. Ives, Westinghouse Air Brake Company, 3400 Empire State building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, P. O. Box 205, Livingston, N. J.

MACHINE SHOP PRACTICE DIVISION.—Erik Aberg, editor, Machinery, 148 Lafayette street, New York.

MATERIALS HANDLING DIVISION.—F. J. Shepard; Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION.—M. J. Reed, 2 West Forty-fifth street, New York.

FUELS DIVISION.—A. R. Mumford, Consolidated Edison Co., 4 Irving Place, New York.

ASSOCIATION OF AMERICAN RAILROADS.—J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.

MECHANICAL DIVISION.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Annual meeting, June 28, 29 and 30, at the Commodore Hotel, New York.

PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York.

MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4468 Oxford avenue, N. D. G., Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, DeSoto Hotel, St. Louis, Mo.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago. Meeting, October 17, 18 and 19, Hotel Sherman, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMEN'S ASSOCIATION. — Roy MacLeod, Room 127, General Office Bldg., N. Y., N. H. & H., New Haven, Conn. Regular meetings, second Friday of January, February, March, April and October at Engineering Societies Bldg., 29 West 39th street, New York.

INDIANAPOLIS CAR INSPECTION ASSOCIATION. — R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILWAY FUEL ASSOCIATION. — See Railway Fuel and Traveling Engineers' Association. Meeting third week in October, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—See Locomotive Maintenance Officers' Association.

LOCOMOTIVE MAINTENANCE OFFICERS' ASSOCIATION.—F. T. James, division master mechanic, D. L. & W., Hoboken, N. J.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Annual meeting, October 17, 18, and 19, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB. — W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Thursday in each month, except June, July, August, September and December at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, 1931 University avenue, St. Paul.

PACIFIC RAILWAY CLUB. — William S. Wollner, P. O. Box 3275, San Francisco, Cal. Monthly meetings alternately in northern and southern California.

RAILWAY CLUB OF GREENVILLE.—Sterle H. Nottingham, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, 1255 Old Colony building, Chicago. Annual meeting October 17, 18, and 19, Hotel Sherman, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

TRAVELING ENGINEERS' ASSOCIATION.—See Railway Fuel and Traveling Engineers' Association.

VALLEY ANTHRACITE CAR FOREMEN'S ASSOCIATION.—P. P. Kohl, executive secretary, 254 Barney street, Wilkes-Barre, Pa. Regular meetings third Monday of each month.

WESTERN RAILWAY CLUB.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

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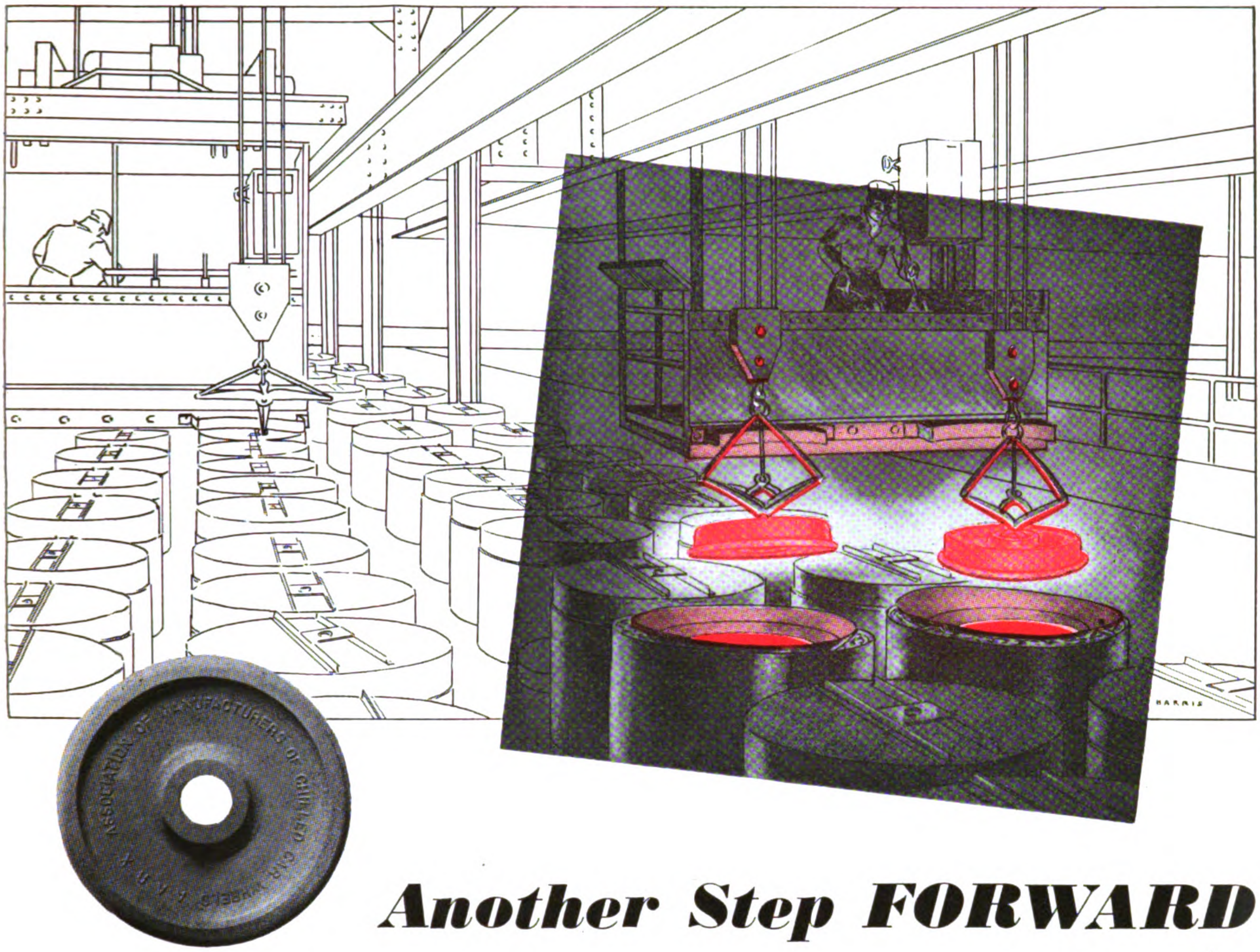

Another Step FORWARD

The new heat treating method developed by our Research Department has so thoroughly proved its value that today, only three years after its introduction, approximately 1000 of these unit pits, with a total capacity of 23,000 wheels, are operating, and 85% of all our production of chilled car wheels is made better by their use.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

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Uniform Specifications
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NEWS

1939 Mechanical Division Letter Ballot Results

In Circular No. DV-969, issued under date of October 23, by the Association of American Railroads, mechanical division, the results of the letter ballots on recommendations of various committees reporting to the session of the division at New York, June 28-30, 1939, are given in detail, a total of 74 individual propositions being involved. As a result of a favorable letter ballot all of these propositions to amend the standard and recommended practice of the division are approved effective March 1, 1940; with the exception of Proposition 4 (a) to 5 (c), inclusive, covering definitions and designating letters which are approved effective immediately; and with the further exception of Propositions 3, 6, 7, 23, 26, 27 and 28 to amend the interchange rules, and Propositions 29 to 74, inclusive, to amend the loading rules, these propositions being approved effective January 1, 1940.

A. A. R. Completes Car-Truck Tests

Tests under actual operating conditions to determine what improvements can be made in the construction of railroad car trucks to enable them to meet with still greater safety, further increases in the speed of freight trains have been completed by the Association of American Railroads according to a recent announcement. The engineers in charge of these tests are now engaged in correlating the data and expect to have a final report early in 1940.

These tests, the most comprehensive of their kind ever conducted by the railroads, began last April and since that time more than 70 test runs at speeds as high as 85 miles per hour were made on the Pennsylvania between Altoona, Pa., and Lock Haven, a round trip of about 150 miles.

Twelve different types of trucks were used in the tests which were made under varying speed, load, weather and operating conditions. In order to determine their qualities or defects, each truck was submitted to a series of separate test runs under a standard freight car which was part of a train containing electrical recording devices, gauges and other paraphernalia designed to record each impulse of the truck under different speed and load conditions.

Simultaneously, tests also were made for the purpose of determining the impact effects on the track of the various makes of trucks. In order to do this an elaborate system of electrical devices was set up along the track to register the impact blows delivered by the wheels of the trucks passing over the rails.

In the past 18 years, the A. A. R. statement points out, there has been an almost constant increase in the average speed of trains with the result that in the first half of 1939, the average speed between terminals was 64 per cent greater than in 1920. As a matter of fact, many freight trains now operate on what formerly were passenger-train schedules.

The road tests which have just been completed were conducted under the general direction of W. I. Cantley, mechanical engineer, Mechanical Division of the Association of American Railroads. W. E. Gray, engineer of draft gear tests was in direct charge of the road tests. G. M. Magee, research engineer of the Engineering Division was in general charge of the track impact tests.

Equipment-Purchasing and Modernization Programs

Atchison, Topeka & Santa Fe.—An improvement program to be undertaken by this road involves the expenditure of approximately $21,000,000 for the purchase of 91,000 tons of rails and fastenings, and 2,800 freight cars, the rebuilding of 2,500 box, auto and refrigerator cars in company shops, an accelerated locomotive and car repair program, and the double tracking of twenty-four miles of its main line from D. T. Junction to Joseph City, Ariz.

The freight cars to be purchased include 1,800 box cars, 200 coal cars, 100 flat cars, 450 refrigerator cars, and 250 gondolas. The box cars will be standard 100,000 lb. capacity cars with roofs lined with an absorbent material to prevent condensation of moisture. Of the refrigerator cars, 300 will be of 40 ft. and 150 will be 50 ft. long. The flat cars will be 70 ft. long and particularly adapted for loading farm machinery and farm implements. The mill-type gondolas will be 56 ft. and 65 ft. long and will be used in special service for loading structural steel. Of the cars to be rebuilt, 900 box cars will be reconstructed in the Topeka shops, 600 automobile cars at the Empire shops in Chicago and 1,000 refrigerator cars at the Wichita shops.

Chicago, Burlington & Quincy.—As reported in the October *Railway Mechanical Engineer*, the C. B. & Q. having been authorized by its directors to acquire locomotives and freight cars, is now asking for prices to determine whether the 10 Mohawk 4-8-4 type locomotives, the 100 53½ ft. flat cars of 50 tons' capacity and the

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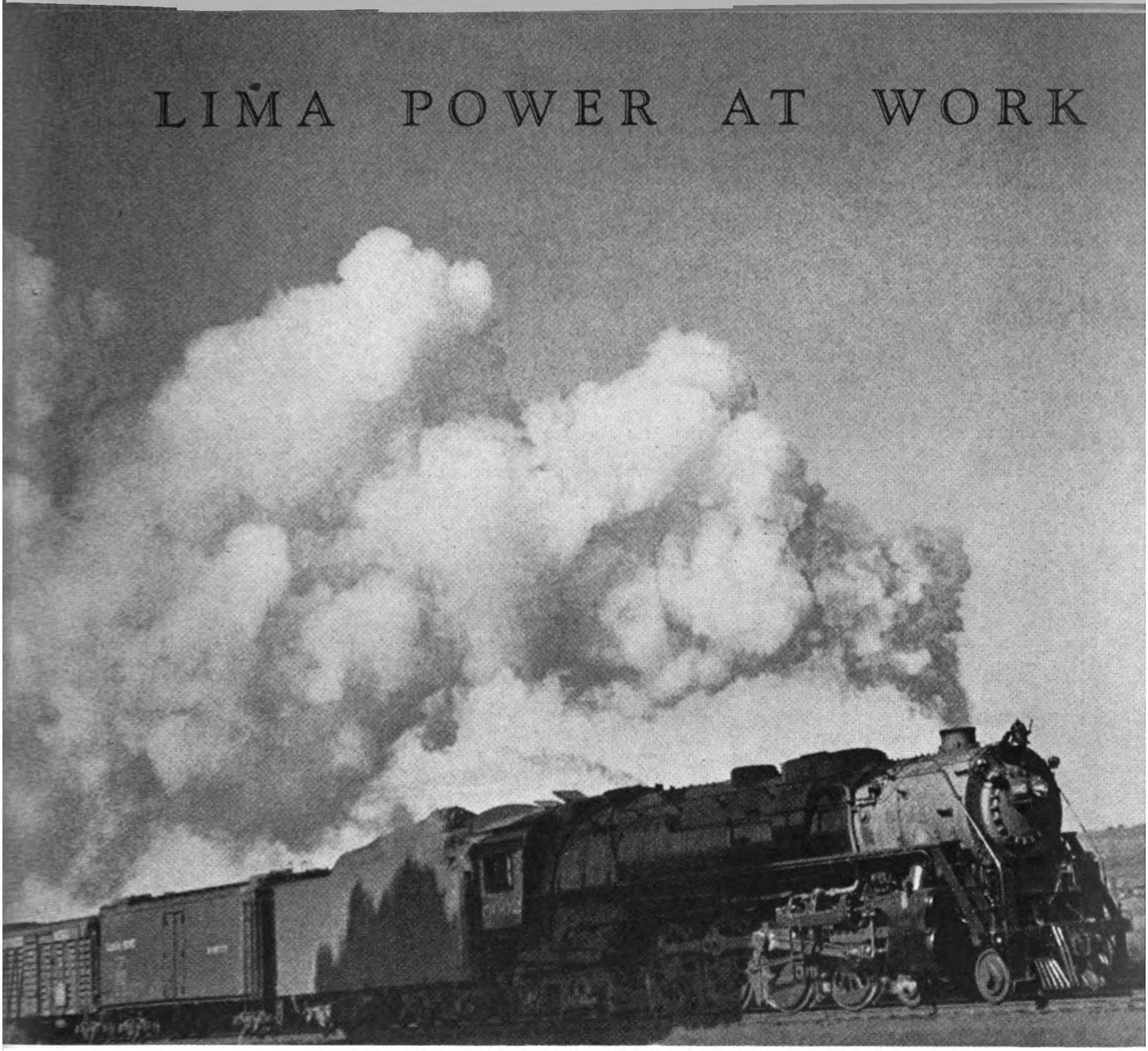


Lima-built 4-8-4 handling fast freight on The Soo Line

MODERN POWER has set today's standards . . . and only Modern Power can meet them

Modern Power hauling full capacity trains at high speeds has proved to be the most effective means of increasing earnings. Only Modern Power is capable of hauling these increased loads at the higher speeds necessary to secure LOWER OPERATING COSTS.

LIMA LOCOMOTIVE WORKS, LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

200 hopper cars of 55 tons' capacity will be purchased or be built in company shops. The seven 2,000 hp. locomotive units which the Burlington will buy, are to be streamlined and built of stainless steel. Six of the units will be operated in pairs on the Exposition Flyer and the Aristocrat, while the remaining unit will be held available for substitute duty on these trains and on the Denver and Twin Zephyrs.

Chicago, Milwaukee, St. Paul & Pacific.—The C. M. St. P. & P. has asked the Interstate Commerce Commission to approve a plan whereby the Reconstruction Finance Corporation would be asked to purchase $5,080,000 of 2½ per cent equipment trust certificates which constitutes 80 per cent of the cost of purchasing 10 freight locomotives and 2,000 50-ton box cars.

Chicago, Rock Island & Pacific.—The district court has authorized the C. R. I. & P. to spend $4,375,000 for equipment and repairs. The program includes the purchase of ten 600 hp. Diesel-electric switching locomotives to cost $625,000; ten 300 hp. to cost $350,000 and 1,000 box cars to cost $2,800,000.

Erie.—The Erie has asked the Interstate Commerce Commission for its approval and has requested the Reconstruction Finance Corporation to purchase $3,000,000 of equipment trust certificates at par, the certificates to mature serially in semi-annual equal payments over a period of 10 years and to bear interest at the rate of 2½ per cent. The funds will be used in part payment of the purchase of 700 box cars, 250 gondola cars, 500 hopper cars and 50 flat cars, the company to pay at least 20 per cent of the purchase price in cash.

Illinois Central. — The Illinois Central has applied for Interstate Commerce Commission approval of a $5,000,000 loan which it is seeking from the Reconstruction Finance Corporation to finance repairs to 51 locomotives and 11,000 freight cars. The loan would run for three years with interest at 2½ per cent. The application states that the I. C. expects that the repair of the 11,000 cars will permit it to reduce its car-hire expenses by an amount sufficient to offset the charges on the loan; while the additional motive power made available by repairing the 51 locomotives will enable the road to handle without loss to competing agencies all traffic anticipated in the near future.

Minneapolis & St. Louis. — The M. & St. L. will spend $1,210,000 in 1940 for improvements in addition to a regular maintenance expenditure of $2,925,000. Included in the improvements are 30 miles of new rails, 100 miles of new ballast, maintenance tools, the rebuilding of freight cars and locomotives and new machine tools.

Minneapolis, Northfield & Southern. — The M. N. & S. plans to purchase three Diesel-electric locomotives for $175,000.

New York, New Haven & Hartford. — The New Haven has placed orders totaling $2,110,000 for rails and new equipment, under federal court approval of the expenditure of $2,800,000 for such purposes in 1940. The cost of the rolling stock will be covered through the issuance of equipment trust certificates for the amount needed and the trustees have sufficient cash on hand to make considerable payments on other equipment which they plan to buy next year. In addition to orders for rail, orders were placed with the American Locomotive Company for 10 Diesel-electric switching locomotives of 660 hp. each; with the Pullman-Standard Car Manufacturing Company for 25 steel caboose cars to be built at Worcester, Mass., and also with Pullman-Standard for 250 high-side, 50-ton coal cars.

The New Haven now has over 1,200 men reconditioning its rolling stock at its Readville, Mass., shops under a $2,000,000 program in anticipation of possible increases in passenger and freight traffic. In the locomotive shops 665 men are at work and by the end of this year the New Haven expects to have over 270 locomotives, from the smallest to the largest, in shape for service at a cost of about $1,500,000. The first of these entered the locomotive shops early last December. In addition, over 250 cars for use in passenger service are being rebuilt including 102 passenger coaches, 100 baggage cars, 25 streamline coaches, 13 mail cars, 8 combination mail-baggage cars and 9 diners. Many of these already are back in service. The freight car shops recently completed repairs on 207 box cars, and are overhauling 100 low-side coal car and 33 flat cars for work service.

The Pennsylvania. — Eighty-five steel coaches will be remodeled in the Altoona, Pa., shops of the Pennsylvania, the work to be started before the close of the year and completed by June 1. Of the 85 cars, 25 will have the interiors constructed in accordance with the Pennsylvania's new long-distance overnight coach design. They will be equipped with individually adjustable reclining and revolving seats for 56 passengers and the exteriors will be streamlined. The remaining 60 will conform with the railroad's new interior coach design for through service not involving overnight travel.

St. Louis-San Francisco.—The St. L.-S. F. will rebuild 1,500 freight cars during 1940.

St. Louis Southwestern. — The federal district court has authorized the expenditure of $501,658 for materials to be used in the construction of 100 general service coal cars, six flat cars, and 12 automobile cars, and the rebuilding of 50 flat cars.

Wabash. — The Wabash will convert 1,000 automobile cars to steel-sheathed box cars. The company has also asked the Interstate Commerce Commission for approval of a loan and the Reconstruction Finance Corporation for a loan of $9,300,000, of which $6,500,000 is to be applied to the retirement of a similar amount of equipment notes issued by the company to the R. F. C., and $2,800,000 to be applied to the cost of repairing and rehabilitating 1,694 automobile box cars.

Wheeling & Lake Erie.—The W. & L. E. has asked the Interstate Commerce Commission for authority to assume liability for $1,200,000 of 2½ per cent equipment trust certificates, series F, to be dated November 15, 1939, and to mature serially in equal annual installments on November 15, in each of the years from 1940 to 1949, inclusive. The proceeds will be used to purchase 500 all-steel self-clearing hopper cars and 200 lightweight Cor-Ten steel box cars of 50-ton capacity.

Mills Becomes I. C. C. Safety Bureau Director

Shirley N. Mills, assistant director of the Interstate Commerce Commission's Bureau of Safety since 1919, has been appointed director to succeed W. J. Patterson, who has been a member of the commission since July 31, having been appointed by President Roosevelt to succeed former Commissioner B. H. Meyer. James S. Hawley, attorney in the I. C. C. Bureau of Safety, succeeds Mr. Mills as assistant director.

Mr. Mills has been identified with I. C. C. safety work for 33 years, having been given that assignment when he joined the staff in 1906. He has been in the employment of the Bureau of Safety continuously since its organization in 1911.

From 1907 until 1912 Mr. Mills was assigned to the Block Signal and Train Control Board, a body of experts employed by the commission to investigate, conduct experimental tests and report upon the use of and necessity for block signal systems, automatic train control devices and other appliances, methods and systems designed to promote the safety of railroad operation. From 1912 to 1914 he was assigned to the Bureau of Safety to continue such investigations and tests, having meantime worked with that Bureau since its establishment on the inauguration of its system of investigating railroad accidents. From 1914 until 1919 Mr. Mills was a Bureau of Safety inspector engaged primarily in investigations and service tests of safety devices and systems and in investigations of accidents.

S. N. Mills

It was in 1919 that the new director became assistant director of the Bureau, and he had been senior assistant director since March 1, 1934. During this post-1919 period Mr. Mills has frequently served as acting director during absences of the director; and during the past two years he supervised the preparation of rules, standards and instructions for the installation, inspection, maintenance and repair of sig-

(Continued on second left-hand page)

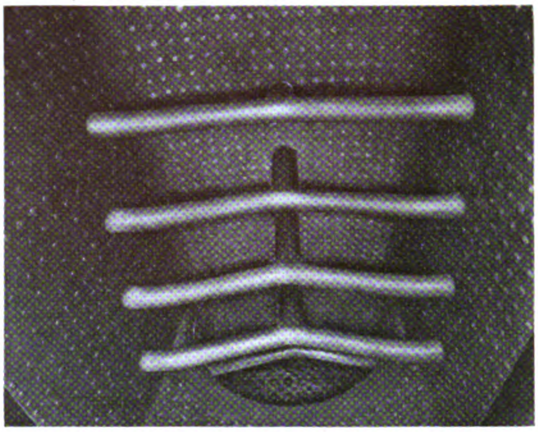
SUCCESSFUL OPERATION

. . . HAVE PROVED THE SECURITY CIRCULATOR

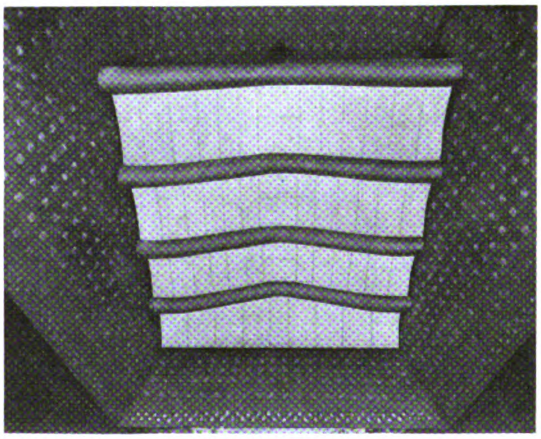
218 Security Circulators (157 of which were installed during the past 14 months) have been installed on 17 railroads, and have operated over 2¼ million locomotive miles in heavy, fast freight and passenger service.

Some of these Circulator-equipped locomotives have operated nearly 300,000 miles.

The Security Circulators in service have proved so successful that an additional 142 Circulators are now on order.



View illustrating the positioning of Security Circulators in an average size of locomotive firebox prior to installing the brick arch.



Typical Security Circulator and brick Arch Installation in a locomotive firebox. The small sectional brick are as readily applied as in an ordinary arch tube firebox.

ARCH COMPANY, INC.

Security Circulator Division

nal appliances and systems recently prescribed by the commission under the Signal Inspection Act of 1937. Also he supervised the development of administrative practices and procedures under that 1937 law which was one of railroad labor's "make-work" measures.

D. L. & W. Seeking Shop Tools and Equipment

THE Delaware, Lackawanna & Western is in the market for 176 miscellaneous shop tools and equipment including approximately 12 large machine tools, which will be installed in its locomotive shops and its car shops.

Brake-Hanger Wear Blocks—A Correction

THE brake-hanger wear blocks, described in an illustrated article on page 396 of the October, 1939, *Railway Mechanical Engineer,* were incorrectly stated to be supplied by the T-Z Railway Equipment Company which, as a matter of fact, has never manufactured or sold any kind of a wear block for this particular service. Brake-hanger wear blocks of somewhat similar design are now widely and successfully used by the railroads, being supplied by the Illinois Railway Equipment Company, Chicago.

Equipment Depreciation Orders

EQUIPMENT depreciation rates for nine railroads, including the Maine Central, the Missouri-Kansas-Texas and the Southern, are prescribed by the Interstate Commerce Commission in a new series of sub-orders and modifications of previous sub-orders in No. 15,100, Depreciation Charges of Steam Railroad Companies. The composite percentages, which are not prescribed rates, range from 2.69 per cent for the Copper Range to 3.68 per cent for the Smoky Mountain, the higher composite percentage of 6.21 per cent listed for the Beaver, Meade & Englewood being merely the prescribed rate for that road's freight cars, the only figure in the present modification of a previous sub-order applicable to the B. M. & E.

The Maine Central's composite percentage of 3.11 is derived from a variety of prescribed rates on equipment owned and leased. On equipment owned the prescribed rates are as follows: Steam locomotives, 2.98 per cent; other locomotives, 6.43 per cent; freight train cars, 2.74 per cent; passenger train cars, 2.54 per cent; work equipment, 3.46 per cent; miscellaneous equipment, 20 per cent. On equipment leased from the Portland & Rumford Falls: Steam locomotives, 4.12 per cent; freight train cars, 11.83 per cent; passenger train cars, 12.3 per cent; work equipment, 3.87 per cent. On equipment leased from the Portland & Ogdensburg: Steam locomotives, 8.01 per cent; freight train cars, 13.8 per cent; passenger train cars, 14.15 per cent; work equipment, 6.04 per cent. On equipment leased from the European & North American: Steam locomotives, 8.84 per cent; freight train cars, 12.25 per cent; passenger train cars, 12.52 per cent; work equipment, 6.62 per cent.

The composite percentage for the M-K-T is 3.45 per cent, derived from prescribed rates as follows: Steam locomotives, 3.45 per cent; freight train cars, 3.26 per cent; passenger train cars (owned), 3.9 per cent; passenger train cars (leased), 3.15 per cent; work equipment, 4.04 per cent; miscellaneous equipment, 12.07 per cent. Prescribed rates for the Missouri-Kansas-Texas of Texas (composite percentage, 3.41) are as follows: Steam locomotives, 3.31 per cent; freight train cars, 4.93 per cent; passenger train cars (owned), 3.24 per cent; passenger train cars (leased), 3.7 per cent; work equipment (owned), 3.19 per cent; work equipment (leased), 4.2 per cent; miscellaneous equipment, 7.34 per cent.

The composite percentage for the Southern is 2.99 per cent, derived from prescribed rates as follows: Steam locomotives, 2.7 per cent; freight train cars, 3.25 per cent. Diesel-electric passenger-train equipment, 4.5 per cent; passenger-train equipment other than that in Diesel-electric trains, 2.5 per cent; floating equipment, 2.75 per cent; work equipment, 3.15 per cent; miscellaneous equipment, 8.04 per cent.

New Equipment Orders and Inquiries Announced Since the Closing of the October Issue

LOCOMOTIVE ORDERS

Road	No. of Locos.	Type of Loco.	Builder
Boston & Maine	3	600-hp. Diesel-elec.	Electro-Motive Corp.
	1	600-hp. Diesel-elec.	American Loco. Co.
Canadian National	15	....	Montreal Loco. Wks.
	10	....	Canadian Loco. Co.
Canadian Pacific	12	....	Montreal Loco. Wks.
	12	....	Canadian Loco. Co.
Central of Brazil	7[1]	2-10-4	American Loco. Co.
	10[1]	2-10-4	Baldwin Loco. Wks.
Chicago & North Western	2[2]	3-unit Diesel-elec.	Electro-Motive Corp.
Chicago, Milwaukee, St. Paul & Pacific	10[3]	4-8-4	Baldwin Loco. Wks.
Ford Motor Co.	3	Diesel-elec. & switch	General Electric Co.
Illinois Central	7	600-hp. Diesel-elec.	
	1	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	2	2,000 hp. Diesel-elec.	
St. Louis-San Francisco	10[4]	Freight	Company shops
Sorocabana Rwy. (Brazil)	4[5]	4-10-2	American Loco. Co.

LOCOMOTIVE INQUIRIES

Road	No. of Locos.	Type of Loco.	Builder
Chilean State Rwys.	10	4-8-2	....
	6	2-8-2	....

FREIGHT CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Atchison, Topeka & Santa Fe	1,800	40-ton box	Pullman-Std. Car Mfg. Co.
	300	40-ton refrigerator	
	100	50-ton refrigerator	
	50	100-ton refrigerator	General American
	100	70-ton flat	
	50	70-ton gondola	
	200	70-ton ballast	Rodger Ballast
	200	50-ton gondola	American Car & Fdry. Co.
Baltimore & Ohio	500	70-ton gondola	American Car & Fdry. Co.
	1,000	50-ton hopper	Bethlehem Steel Co.
	500	Box	Pressed Steel Car Co.
Bessemer & Lake Erie	1,000	90-ton hopper	Pullman-Std. Car Mfg. Co.
	500	50-ton gondola	Pressed Steel Car Co.
	500	50-ton box	Greenville Steel Car Co.
	50	Hopper	American Car & Fdry. Co.
Canadian National	1,075	Box	Eastern Car Co.
	590	Box	National Steel Car Corp.
	1,100	Box	Canadian Car & Fdry. Co.
	500	Flat	
Canadian Pacific	200	Refrigerator	National Steel Car Corp.
	500	Box	
	500	Box	Canadian Car & Fdry. Co.
	100	Automobile	
Central of Brazil	100	30-ton flat	
	200	30-ton box	American Car & Fdry. Co.
	200	30-ton gondola	
	250	Box	
	150	Flat	Pullman-Std. Car Exp. Corp.
	100	Gondola	
Chicago & Illinois Midland	50	Hopper	Pullman-Std. Car Mfg. Co.
Chicago Great Western	100	50-ton flat	Pullman-Std. Car Mfg. Co.
Chicago, Milwaukee, St. Paul & Pacific	2,000[3]	50-ton box	Company shops
Chicago, Rock Island & Pacific	1,000	50-ton box	Pressed Steel Car Co.
Elgin, Joliet & Eastern	600	50-ton twin hopper	American Car & Fdry. Co.
	50	50-ton covered hopper	
Great Northern	750	75-ton ore	Pressed Steel Car Co.
	750	75-ton ore	Bethlehem Steel Co.
Inland Steel Co.	50	70-ton mill-type gondola	General American
Lehigh & New England	75[6]	70-ton hopper-bottom	American Car & Fdry. Co.
Louisiana & Arkansas	300	50-ton box	American Car & Fdry. Co.
Louisville & Nashville	600	50-ton hopper	American Car & Fdry. Co.
	600	50-ton hopper	Pullman-Std. Car Mfg. Co.
Maine Central	10	70-ton hopper	American Car & Fdry. Co.
Nevada Consolidated Copper Co.	30	Air-dump	Austin-Western Rd. Mchy. Co.
Northern Pacific	500	50-ton box	American Car & Fdry. Co.
	150	50-ton hopper	
	200	Hopper	General American
	500	Box	Pullman-Std. Car Mfg. Co.
	500	Gondola	Pressed Steel Car Co.
	50	Hopper	American Car & Fdry. Co.
	100	70-ton ballast	
St. Louis Southwestern	See footnote[7]		
Seaboard Air Line	700	50-ton box	Pullman-Std. Car Mfg. Co.
	100	70-ton hopper	Bethlehem Steel Co.
	100	50-ton flat	American Car & Fdry. Co.
Tennessee Central	65	50-ton hopper	American Car & Fdry. Co.

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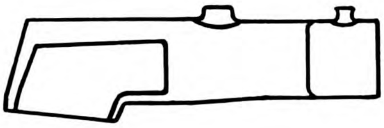

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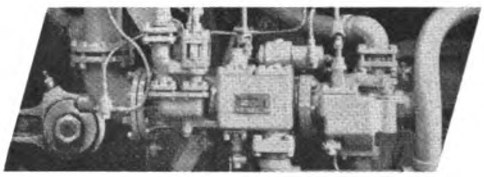
Boiler Maintenance

when the boiler feed-water is preheated <u>at all times</u>, and...

Less

Maintenance on the Pumping Equipment

when it is an Elesco Exhaust Steam Injector, as there are no continuously moving parts to maintain.



ELESCO

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Superheaters • Exhaust Steam Injectors • Feedwater Heaters • American Throttles • Pyrometers • Steam Dryers

New Equipment Orders and Inquiries

(*Continued from page 519*)

FREIGHT-CAR ORDERS

Texas & Pacific	500	50-ton box	Mt. Vernon Car Mfg. Co.
Union Railroad Co.	60	Air-dump	Differential Steel Car Co.
	40	Air-dump	Magor Car Corp.
U. S. Navy Dept., Bureau of Supplies and Accounts	15	50-ton flat	American Car & Fdry. Co.
	8	50-ton box	American Car & Fdry. Co.
	8	50-ton gondola	American Car & Fdry. Co.
	1	50-ton hopper	American Car & Fdry. Co.
	17	Flat	Haffner-Thrall Car Co.
U. S. War Dept., Chief of Engineers	125	Tank	American Car & Fdry. Co.
Utah Copper Co.	100	100-ton ore	Pressed Steel Car Co.
Youngstown & Northern	100	70-ton gondola	Magor Car Corp.

FREIGHT-CAR INQUIRIES

Road	No. of Cars	Type of Car	Builder
Atchison, Topeka & Santa Fe	27	80-ton ore	....
Delaware, Lackawanna & Western	500	50-ton box	....
	500	50-ton hopper	....
	100	70-ton gondola	....
Lehigh Valley	200-300	70-ton gondola	....
	50	70-ton gondola	....
New York, New Haven & Hartford	500-1,000	50-ton box	....
Norfolk & Western	1,000	70-ton hopper	....
Union Pacific	500-1,000	50-ton ballast	....

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Canadian Pacific	10	Mail and express	Natl. Steel Car Corp.
Chicago & North Western	28[2]	....	Pullman-Std. Car Mfg. Co.

[1] These locomotives will be of meter gage and will have 20-in. by 24-in. cylinders, 48¾-in. drivers, and will weigh 248,000 lb. in working order.

[2] The Chicago & North Western has been authorized by the federal district court to participate to the extent of $700,000 in the purchase of two 14-car streamlined trains, which will cost $3,270,000, and which will be placed in operation between Chicago and California. Both trains will be hauled by three locomotive units of 2,000 hp. each to be built by the Electro-Motive Corporation. The 28 revenue cars comprising the train will be of lightweight construction, and will be built by the Pullman-Standard Car Manufacturing Company. Of these 28 cars, 15 roomette double bedroom compartment, master bedroom and section cars will be owned by the Pullman Company, while 13 baggage, dining, coach and observation cars will be owned by the railroads. One train, the new Forty-Niner, will be owned jointly by the Chicago & North Western, the Union Pacific, and the Southern Pacific, and will be operated between Chicago and San Francisco. The new City of Los Angeles will be owned jointly by the Chicago & North Western and the Union Pacific, and will operate between Chicago and Los Angeles. The present equipment of these trains will be used elsewhere.

[3] Authorized by federal district court.

[4] To be constructed in 1940. They are in addition to five now nearing completion.

[5] These locomotives will be of meter gage and will have three cylinders, two of 17½ in. by 24 in. and one of 17½ in. by 22 in. They will have 48- in. driving wheels and will weigh 246,000 lb. in working order.

[6] Special type hatchway roof, hopper bottom cars for bulk cement loading.

[7] The St. Louis Southwestern has ordered from the American Car & Foundry Co., 100 car sets of steel underframes and superstructures and fabricated steel parts for 40-ft. convertible ballast and coal cars. An order has also been placed for 56 steel underframes for flat cars of 40 tons' capacity and 42 ft. long.

I. C. C. Organization Changes

SEVERAL changes in the organization of the Interstate Commerce Commission's work were announced in an August 9 notice by Secretary W. P. Bartel. Under the new set-up the Bureau of Valuation will report to Commissioner Miller instead of Commissioner Lee; the Bureau of Informal Cases will report to Commissioner Lee instead of Commissioner Caskie; the Bureaus of Safety and Locomotive Inspection will report to Commissioner Patterson instead of Commissioner Miller; and Commissioner Patterson has been made a member of Division 3 in lieu of Commissioner Miller.

Under the I. C. C.'s internal reorganization plan which became effective in July, as reported in the July *Railway Mechanical Engineer*, page 301, Division 3 is the one which administers the Safety Appliance and related acts, such as Locomotive Inspection, Transportation of Explosives; emergency directions as to car service; pooling of traffic; and the classification of railroad employees under the Railroad Retirement Act and the Railroad Unemployment Insurance Act.

Pioneer Zephyr in Collision with Freight Locomotive

THE "Pioneer Zephyr" of the Chicago, Burlington & Quincy, while en route from Kansas City, Mo., to Omaha, Neb., on October 2, encountered an open switch and collided with a freight locomotive which was taking water near Napier, Mo. The engineman of the Zephyr was killed and five other trainmen were injured. The accident occurred while the train was passing through the yards at Napier.

Equipment Installations and Orders Since January 1

NEW freight cars placed in service or ordered by the Class I railroads in the first nine months this year totaled 37,757, according to the Association of American Railroads. Of that number 14,704 have been put in service since January 1 this year and 23,053 were on order on October 1, 1939.

Class I railroads in September placed orders for 16,497 new freight cars, which exceeded by 1,793 cars the number of new freight cars put in service in the first nine months this year. Of the total number for which orders were placed in September, 10,774 were coal cars and 5,413 were box cars. Orders also were placed for 310 new flat cars. Out of the 23,053 new freight cars on order, 4,835 are to be built in railroad shops while the remainder are to be constructed by private car-building concerns.

New steam locomotives on order on October 1, 1939, totaled 68, of which five were ordered in September. New electric and Diesel-electric locomotives on order on October 1 totaled 40, orders for nine having been placed in September.

New steam locomotives put in service in the first nine months totaled 45, 13 having been installed in September. New electric and Diesel-electric locomotives put in service in the nine months' period this year totaled 157 of which 23 were installed in September.

In the figures relating to new freight cars on order, only those for which orders have actually been placed up to October 1 this year are included. Freight cars and locomotives leased or otherwise acquired are not included.

Second "Mercury" Completed

THE New York Central will place in service on November 12 between Chicago and Detroit the second "Mercury" train recently completed at its Beech Grove shops. The present Mercury, placed in service between Cleveland and Detroit in 1936, will be continued in that service.

The new train consists of a Hudson type passenger locomotive, painted in the Mercury's dark gray color scheme, and 11 cars, including a baggage car, six coaches, a dining car, a kitchen car, a lounge car and a parlor observation car. Although lighter than standard cars, they are full size and combine beauty with comfort and utility. The coaches have spacious vestibules, that are semi-circular and warmly colored and which make entrance and exit into the car with baggage much easier. Each coach has a smoking lounge for the use both of men and women passengers. Floors, walls and ceilings of the cars are insulated, while the trucks are equipped with roller bearings.

Dining facilities take up the entire dining car, which seats 56 persons, while the kitchen is in an adjoining car. The former is divided by glass partitions into three dining rooms, the center room having banquet seats along the sides. A waiting room, seating six, at one end is another feature of this car. An electric eye operates the head-end door leading into the kitchen car.

The lounge car has a semi-circular service bar, located midway in the car. The parlor observation car has a solarium with leather seats facing outward.

President Brown of Johns-Manville Receives Franklin Institute Medal

LEWIS H. BROWN, president, Johns-Manville Corporation, New York, will be awarded the W. M. Vermilye medal, "in recognition of outstanding contribution in the field of industrial management," by the Franklin Institute, Philadelphia, Pa., on November 14. The first recipient of the award, Mr. Brown has been president of Johns-Manville since 1929. His selection is based upon the report of an advisory committee which includes W. L. Batt, chairman, president of SKF Industries; C. E. Brinley, president, Baldwin Locomotive Works; and R. A. Wentworth, representing the American Society of Mechanical Engineers.

Supply Trade Notes

Otto V. Kruse has been elected a member of the board of directors of the General Steel Castings Corporation, Eddystone, Pa. Mr. Kruse is general sales manager of the Baldwin Locomotive Works.

◆

The Markham Supply Company, 310 South Michigan avenue, Chicago, has been appointed railway sales representative of the H. K. Porter Company, Inc., Pittsburgh, Pa.

◆

Henry N. Gardner has been elected vice-president of the Hullson Grate Company, Keokuk, Iowa, in charge of sales in the eastern territory. Mr. Gardner, who is located at 35 Astral avenue, Providence, R. I., was born in South Swansea, Mass., on April 28, 1896. He completed public school and business college courses at Fall River, Mass., and for a short time served the New England Steamship Company in clerical capacities. He then became a service man and salesman in the employ of the Packard Motor Company, Inc., at Providence. In 1916 he entered the service of the New York, New Haven & Hartford as a locomotive fireman, advancing to locomotive engineman in 1926. In September, 1927, Mr. Gardner became service engineer of the Hulson Grate Company, and from 1934 until his election as vice-president he was special representative, sales, tests and service, eastern territory.

H. N. Gardner

◆

The Symington-Gould Corporation, Rochester, N. Y., has dissolved its wholly owned subsidiary, Gould Coupler Corporation. The Depew plant will be operated as the Gould Coupler Works of the Symington-Gould Corporation, with no change in local management.

◆

The Linde Air Products Company, the Oxweld Railroad Service Company, the Carbide & Carbon Chemicals Corporation, the Union Carbide Company, the Electro Metallurgical Company and the Haynes Stellite Company, units of the Union Carbide & Carbon Corp., have moved their general publicity department headquarters from 205 East Forty-second street, New York, to the Carbide & Carbon building, 30 East Forty-second street, New York.

◆

E. T. Schroeder, Syndicate Trust building, St. Louis, Mo., has been appointed representative in the Southwest for the Valve Pilot Corporation, New York. Rowland S. Folk has joined the staff of the Valve Pilot Corporation, attached to its sales organization in its New York office.

◆

R. Carson Dalzell has been appointed technical adviser of the Baltimore division of the Revere Copper and Brass Incorporated, with headquarters at 1301 Wicomico street, Baltimore, Md.

Obituary

Charles C. King, of the railroad department of the Detroit Lubricator Company, Detroit, Mich., died suddenly in that city on September 24.

◆

W. A. Berger, sales engineer and eastern representative of W. H. Miner, Inc., with headquarters at Chicago, died in that city on October 4.

◆

William G. Tawse, service engineer for The Superheater Company, with headquarters at Chicago, died on October 5. Mr. Tawse was born in 1870 at Aberdeen, Scotland. At the age of 18 he started his railroad career with the Grand Trunk. In July, 1894, he served as a locomotive engineman on the Baltimore & Ohio, and in 1902 was promoted to fuel supervisor. The following year he was transferred to the Chicago & Eastern Illinois as road foreman of engines. In January, 1911, Mr. Tawse joined The Superheater Company as service engineer out of Chicago. In 1914 he was transferred to the Pacific Coast, where he continued to represent the company until his demise. He took a prominent part in the work of the Traveling Engineers' Association and was identified with several other associations.

◆

Arthur L. Humphrey, who retired as chairman of the executive committee of the Westinghouse Air Brake Company on December 31, 1938, died at his Edgewood home, Pittsburgh, Pa., on November 1, following a lingering illness. Comparatively inactive for the past year, Mr. Humphrey had been identified continuously with the Westinghouse Air Brake Company since his affiliation in 1903 as western manager, with headquarters in Chicago. From the general managership of the company, which he assumed in 1905, at which time he moved to Pittsburgh, he rose successively to the position of vice-president and general manager in 1910; was elected a director in 1913, and succeeded to the presidency in 1919, at which time he also became a member of the executive committee. In 1932 he became an executive director; in 1933, chairman of the board, and in 1936, chairman of the executive committee.

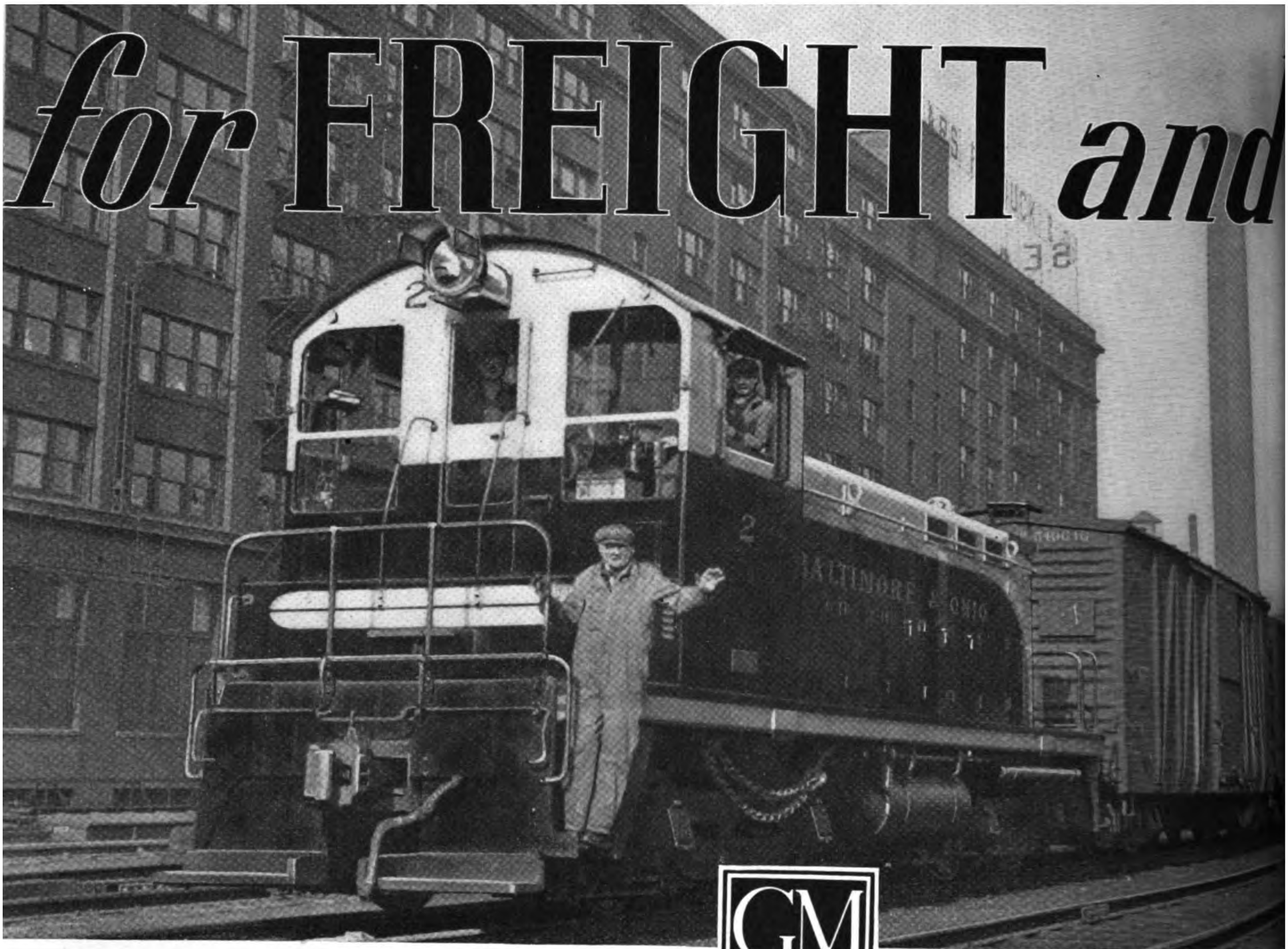
Mr. Humphrey gained national prominence for his services during the World War. In addition to the extensive activities of the companies which he headed in producing munitions, he was industrial "staff expert" for Brig. Gen. C. C. Williams, chief of the Ordnance Department. He was also a member of the Committee on Labor of the Council of National Defense, as well as a member of the War Industries Board and the War Resources Committee.

Born in Buffalo, N. Y., June 12, 1860, Mr. Humphrey was taken when one year of age to the farming region of the Midwest, where he attended the country schools of Maquoketa, Iowa, and Plattsmouth, Neb. He left the farm at the age of 14, taking a position as a drug clerk in Plattsmouth. In 1877 he became a machinist apprentice on the Burlington & Missouri River Railroad, a part of what is now known as the Chicago, Burlington & Quincy Railroad. At the age of 22 he organized a general machine shop and foundry in Seattle, Wash., which afterwards became the Moran Iron Works. He re-entered railway service and became constructing division foreman of the Mojave division of the Central Pacific, then master mechanic, and later superintendent motive power of the Colorado Midland. He became interested in politics and was elected to the Colorado House of Representatives in 1892. Re-elected, he served as Speaker of the House during his second term. He returned to railroad service on the Colorado & Southern in 1899 and in 1903 went to the Chicago & Alton as superintendent of motive power. This position he relinquished to join the Westinghouse Air Brake Company in the capacity of western manager, with headquarters in Chicago, in 1903. Among the many other organizations with which Mr. Humphrey was associated either as a director or as an executive were the following: Union Switch & Signal Company, Pittsburgh; National Brake & Electric Company, Milwaukee; Westinghouse International Brake & Sig-

A. L. Humphrey

(Continued on second left-hand page)

for FREIGHT *and*



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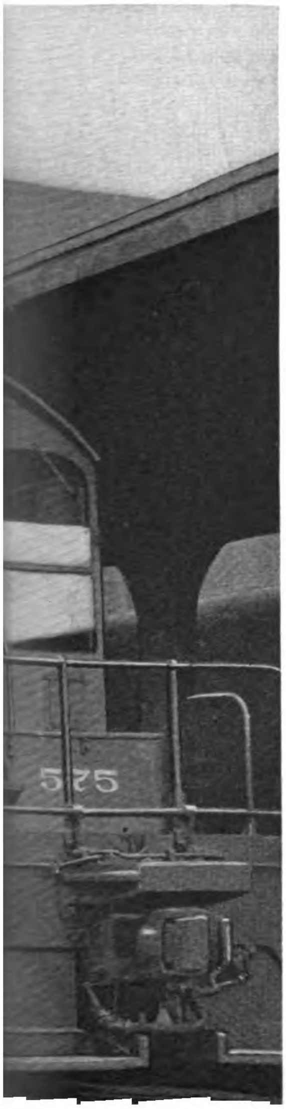

PASSENGER *Terminals*

YOU CAN NOT BEAT DIESEL OPERATION

because

- Fuel costs are reduced 75 per cent and overall locomotive costs reduced 50 per cent.
- EMC Availability has averaged 94 per cent resulting in fewer locomotives required to handle 24-hour operation.
- Diesel efficiency is uniformly high throughout entire year.
- EMC "Clear-View" type locomotives give superior visibility, permitting faster and safer switching.
- High starting tractive effort enables Diesels to start heavy trains and negotiate steep grades.
- Rapid and smooth acceleration and deceleration speed up yard movements.
- Exact power control at all speeds reduces coupling shocks to passengers and minimizes damage to cars and lading.
- Expensive supporting facilities such as coal docks, ash pits, water stations, are eliminated at fully Dieselized terminals.
- EMC Diesels pave the way to added economies and benefits resulting from cleaner, quieter and smokeless operation.

Frequently EMC Diesel Switchers save $1000.00 per month over carrying and amortization charges and pay for themselves in five years. No other type of motive power can match these savings.

ELECTRO-MOTIVE CORPORATION

SUBSIDIARY OF GENERAL MOTORS LA GRANGE, ILLINOIS, U. S. A.

nal Company; American Brake Company of St. Louis; American Brake Shoe & Foundry Company; Canadian Westinghouse Company, Ltd., of Hamilton, Canada; Safety Car Devices Company; Westinghouse Pacific Coast Brake Company of Emeryville, Cal.; Westinghouse Traction Brake Company; Bendix Westinghouse Automotive Air Brake Company; Westinghouse Electric & Manufacturing Company; Wilmerding Corporation; trustee of the University of Pittsburgh.

◆

ERNEST A. LEBEAU, representative of the Chicago Railway Equipment Company, with headquarters at Chicago, died in that city on October 1. He had been ailing since January.

◆

FREDERICK C. CAMERON, until recently assistant director of sales at the Corning Glass Works, Corning, N. Y., died on September 29, at his home in Corning, after an extended illness.

Personal Mention

General

CHARLES J. SCUDDER, chief of motive power of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., has been relieved of the duties of that position at his own request and has been appointed consulting engineer of motive power. Mr. Scudder was born at Saginaw, Mich., on September 21, 1873, and entered railway service in 1888 as a machinist ap-

Charles J. Scudder

prentice on the Flint & Pere Marquette (Pere Marquette). In 1898, he became machinist on the Detroit, Grand Rapids & Western (Pere Marquette) at Ionia, Mich., and in 1906, became master mechanic on the Cincinnati, Hamilton & Dayton (Baltimore & Ohio) at Cincinnati, Ohio. Mr. Scudder was appointed general foreman, Pere Marquette, at Chicago, in 1908; superintendent shops at Saginaw, Mich., in 1909; and master mechanic in 1910. In 1911 he became a locomotive inspector of the Interstate Commerce Commission and in 1917 was appointed supervisor of equipment, United States Railroad Administration. Mr. Scudder was appointed superintendent of shops for the Delaware, Lackawanna & Western at Scranton, Pa., in 1919 and became superintendent motive power and equipment at Scranton in 1923. He has been chief of motive power since 1936.

O. J. PROTZ, assistant master mechanic on the Chicago & North Western at Clinton, Iowa, has been promoted to superintendent of the locomotive and car shops at Chicago, succeeding George H. Logan, who has retired.

EDWARD E. ROOT, assistant chief of motive power of the Delaware, Lackawanna & Western, has been appointed chief of motive power, succeeding Charles J. Scudder. A photograph of Mr. Root and a biographical sketch of his railway career, were published in the July *Railway Mechanical Engineer* when he became assistant chief of motive power.

J. P. BECKER, master mechanic of the Chicago Great Western at Oelwein, Iowa, has been appointed assistant to superintendent of motive power, with headquarters at Oelwein. Mr. Becker, in this newly-created position, will have jurisdiction over matters pertaining to general locomotive inspection, design, standards and tests.

JOSE MORALES SANCHEZ, superintendent of motive power and machinery of the Southern Pacific of Mexico, with headquarters at Empalme, Son., Mex., has resigned to return to his former position of assistant general superintendent of motive power and machinery of the National Railways of Mexico, with headquarters at Mexico, D. F.

Master Mechanics and Road Foremen

A. W. BYRON, master mechanic of the Pennsylvania at West Philadelphia, Pa., has been transferred to Wilmington, Del., and will succeed C. O. Shull.

C. T. HUNT, assistant master mechanic of the Pennsylvania at Mingo Junction, Ohio, has been appointed master mechanic at West Philadelphia, Pa., succeeding A. W. Byron.

C. O. SHULL, master mechanic of the Pennsylvania at Wilmington, Del., has been transferred to a similar position at Juniata, Pa. Mr. Shull was born on February 9, 1894, at Williamsport, Pa. He graduated from Cornell University in 1917. He began his railway service on August 5, 1909, being employed consecutively by the Pennsylvania as messenger, shop hand, apprentice, motive-power inspector, general foreman and assistant master mechanic. He then became successively master mechanic at Sharpsburg, Chicago, Pitcairn and Wilmington. His transfer to Wilmington was announced in the August issue.

Car Department

K. H. CARPENTER, general car inspector of the Delaware, Lackawanna & Western at Scranton, Pa., has been appointed assistant superintendent of the car department with the same headquarters. The position of general car inspector has been abolished.

H. C. FISHER, foreman of the passenger car shop of the Norfolk & Western, has been appointed superintendent of the car department, with headquarters at Roanoke, Va., succeeding S. P. Seifert, retired.

CRESCENCIO NEAVES has been appointed master car builder of the National Railways of Mexico, succeeding Pedro Contreras, who has retired.

S. P. SEIFERT, superintendent of the car department of the Norfolk & Western at Roanoke, Va., has retired. Mr. Seifert entered the service of the Norfolk & Western in 1891 as a car builder. Two years later, he became gang foreman in the car department. He then served successively as assistant foreman, supervisor, and superintendent. For 21 years of his almost half-century service with the N. & W., Mr. Seifert was superintendent of the car department.

P. H. MITCHELL, master car builder of the Delaware, Lackawanna & Western, has been appointed superintendent car department, with headquarters at Scranton, Pa. Mr. Mitchell was born at Prescott, Ark. He entered railroad service as a car repairman with the Prescott & Northwestern and subsequently was employed as a car foreman on the Memphis, Dallas & Gulf (now part of the Graysonia, Nashville & Ashdown and the Murfreesboro-Nashville) at Nashville, Ark. Leaving that company

P. H. Mitchell

Mr. Mitchell entered the employ of the San Antonio, Uvalde & Gulf as air-brake inspector and steam-heat supervisor, later returning to the Memphis, Dallas & Gulf as master car builder. He was general car inspector of the Texas & Pacific, at Dallas, Tex., prior to entering the service of the Delaware, Lackawanna & Western in 1936. Mr. Mitchell served as general car inspector of the Lackawanna at Scranton until March, 1938, when he was appointed master car builder, a position which has now been abolished.

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See page 523

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December, 1939

Volume 113 *No. 12*

Locomotive:

Car:

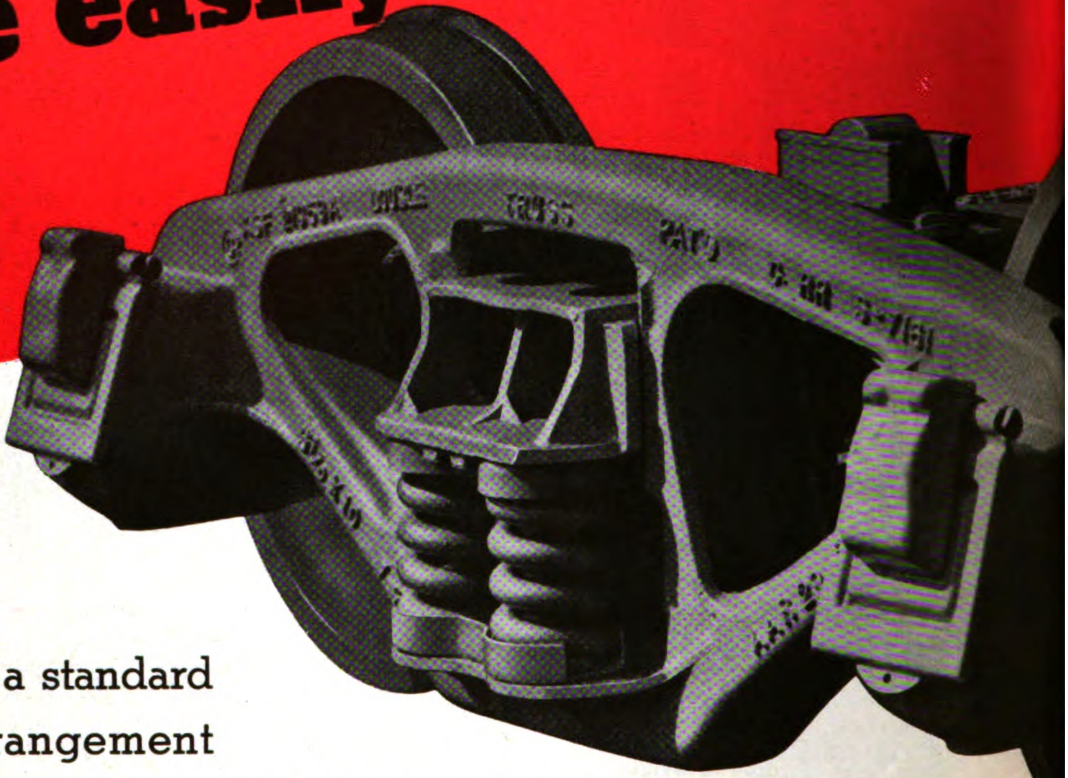
General:

Editorials:

Backshop and Enginehouse:

Car Foremen and Inspectors:

Springs of the SELF-ALIGNING TRUCK are easily accessible



THEY present a standard balanced arrangement on a large one-level spring seat. Because of their accessibility, changing the springs is easy and simple.

Accessibility applies to shimming, too . . . a simple rectangular shim can be slipped in above each top spring plate when necessary.

Quick inspection is another advantage that arises from the standard spring and bolster arrangement of the Self-Aligning Truck.

OVER 65,000 CAR SETS OF SELF-ALIGNING TRUCKS HAVE BEEN ORDERED

AMERICAN STEEL FOUNDRIES

RAILWAY
MECHANICAL ENGINEER

Experience with Diesel-Electric Locomotives in

Seaboard Florida Service*

By E. H. Roy†

THE Seaboard Air Line recently placed nine 2,000 hp. Diesel-electric locomotive units in service on the "Orange Blossom Special" between Washington, D. C., and Miami, Fla. This service, in conjunction with that of the Pennsylvania Railroad, provides continuous electric operation for the entire distance New York to Miami.

The mileage between Washington and Miami is 1,145 making a round trip of 2,290 miles. The schedule was such that the Orange Blossom Special left Washington at 6:10 p. m. and arrived at Miami at 3:40 p. m. the following day. This gave a layover at Washington of approximately seven hours and a layover at Miami of approximately 20½ hours. It was, therefore, decided that the main maintenance point should be at the southern end of the run; the Seaboard's maintenance point being at Hialeah, 3.6 miles from Miami station.

With this schedule it was anticipated that sufficient time would be available at Miami for the necessary maintenance to enable us to obtain 100 per cent availability on the locomotives. From the engineering data, it was decided to increase the Orange Blossom Special to 15 cars. Previously this was a 12-car steam train out of Washington.

A Typical Run

I should like to outline a trip from Washington to Miami and return, pointing out en route the various facilities set up for maintaining the service. We leave Washington at 6:10 p. m. (say Monday) traveling over the R., F. & P. tracks to Richmond, Va. This is a distance of 116 miles. At Richmond we change crews and pass onto the main line of the Seaboard.

Shortly after midnight we reach Hamlet, N. C., our first service stop, a distance of 370 miles from Washington. At this point we take aboard fuel oil and water from overhead tanks and ice and water the train, the layover being 10 minutes. The water we take aboard the Diesel locomotives is for the steam generators which maintain steam pressure for heating the train.

We reach our next service stop, Wildwood, Fla. (a distance of 496 miles from Hamlet) shortly before noon, Tuesday, where we again take fuel oil and water from overhead tanks and ice and water the train. We arrive in Miami at 3:40 p. m.

The train is immediately taken to our shop at Hialeah for inspection and regular routine maintenance. The equipment is first placed on the coach cleaning tracks and the Diesel locomotives are then moved over an electric lighted inspection pit of sufficient length to accommodate three locomotive units.

Our schedule of inspection and maintenance has been organized as a result of experience since these locomotives were introduced on the railroad and, of course, may have to be altered as conditions justify. The present procedure is as follows:

When the locomotives reach the inspection pit, the first operation is to vacuum clean the interior, especially around the engines. By this, I mean that all crevices

* Abstract of a paper presented before the New England Railroad Club at Boston, Mass., November 14, 1939.
† General Superintendent of Motive Power, Seaboard Air Line.

and cracks where dust or dirt might collect are given thorough attention. We have found by experience that cleanliness of the interior of the locomotive is a most important factor in satisfactory operation.

While the interior cleaning is being done, exterior and underneath inspection is given, at which time traction motor brushes and commutators are examined for wear and all other underneath parts are carefully checked and lubricated with clean grease or oil. The draft gear is also inspected; the air brake piston travel adjusted as needed, and the train control and air brake equipment are tested.

After the engine room has been thoroughly cleaned, mechanics check the condition of generator brushes and commutators, relays, contactors, fans and fan belts and renew, clean and lubricate such parts as require it. The engine air box cover plates are removed to enable an inspection of pistons and piston rings, connecting rods, and connecting rod bearings. Samples of oil from the engine are taken and checked both for cleanliness and quality of the lubricant. Air filters, lubricating oil, and fuel oil filters are removed, cleaned and replaced.

The steam generators (used for train heating) are also inspected and tested at this time and cleaned, if necessary.

Maintenance Shop Facilities

To facilitate wheel and traction motor changes, we have installed at one end of the inspection pit a horseshoe-type drop table, enabling the dropping of one pair of wheels or the entire 6-wheel truck. This facility is unique in that no jacks are needed to raise or support the locomotive while a wheel change is being made.

The Diesel locomotive repair shop, storeroom and oilroom are located in one building, 20 feet by 150 feet, close to and parallel with the inspection pit, and partitioned to separate the departments. The repair shop contains 1,700 sq. ft. of floor space and is equipped with a small drill press, valve grinder and combination emery and buffer wheel stand (all electrically driven), also a 40-ton arbor press (hand operated), and suitable assortment of small tools peculiar to this work.

The oilroom contains 480 sq. ft. of floor space and here are installed small rotary pumps for handling clean lubricating oil from the storage tank (located outside the building) direct to the oil tanks aboard the locomotives, or for emptying the dirty oil tank (which is located underground) and into which all dirty crank case oil is drained direct from the Diesel engines when oil changes are made. This room also contains an oil purifier (capacity 75 gallons per 75 minutes) which was recently installed, and from which we hope to obtain substantial savings in the cost of lubricating oil.

The remaining 820 sq. ft. of floor space in this building is set aside for the storage of various small repair parts for Diesel locomotives.

The Return Trip

The following day the Orange Blossom Special departs from Miami at 1:20 p. m. for New York. The first service stop out of Miami is Wildwood, Fla., where we take on fuel oil and water. Wildwood is 279 miles from Miami; making 558 miles since the last refueling. The next service stop is at Hamlet, N. C., where fuel and water are taken on again while the train is being iced and watered.

Arriving at Washington, D. C., the following morning at 11:00 o'clock, the Diesel locomotive is cut off and taken to the enginehouse of the Washington Terminal Company for inspection; no routine maintenance is done at this point.

During last winter, on this schedule, these locomotives gave an availability of 100 per cent for the service to which they were assigned.

Engine crews were changed at Richmond, Va., Johnson Street (Raleigh, N. C.), Columbia, S. C., West Savannah (Savannah, Ga.) and Baldwin, Fla., in both directions, and at those points, we have emergency water stations at which water can be taken, if necessary, in extremely cold weather.

A Diesel locomotive attendant, selected from the ranks of the shopmen, who has been given special training was constantly on duty in the engine room and was able quickly to detect and to correct unusual conditions which, if allowed to continue, might eventually result in serious trouble and delay.

A small assortment of repair parts is carried aboard each set of units. Pistons and liners can be renewed and other repairs made en route, greatly contributing to the satisfactory performance of these locomotives.

Other Train Service

At the close of the winter season, April 16, the Diesel locomotives immediately were transferred to the Southern States Special, and portions of the runs of the Cotton States Special and The Robert E. Lee trains, replacing steam power. Their northern layover was changed from Washington, D. C. to Richmond, Va., which arrangement will remain in effect until December 15, when the Orange Blossom Special will be restored and the Diesels returned to this train for the winter months.

The Southern States Special, insofar as the locomotives are concerned, originates at Miami. Two Diesel units are used as a locomotive for this train on the run to Richmond. A layover of 9½ hours is available at Richmond for any servicing which might be required. The locomotive is then dispatched on the Southern States Special as far as Hamlet, N. C., where it is detached and placed on the Cotton States Special for Atlanta, Ga. The layover at Atlanta is 6 hours 50 minutes, after which time it is used on The Robert E. Lee back to Hamlet and there placed on the Southern States Special for Miami.

By this arrangement, we are able to return each locomotive every fourth day to the Diesel shop at Hieleah for routine inspection and maintenance as previously outlined.

Crew change, fueling and watering points are the same as was in effect during the winter season.

Prior to running the Diesels out of Richmond we had no facilities at that point except those which were being used for steam power. It has been our policy to divorce the operation of Diesel locomotives from that of steam for many reasons; therefore, with this purpose in view, new Diesel facilities were provided. The consist of these shop facilities was given earlier in this paper.

Why the Seaboard Uses Diesels

Perhaps many of you wonder why the Seaboard decided to make use of this class of equipment. I believe you will agree the primary consideration of all railroads today is to increase business. An increase in business means an increase in revenue. In this particular case, we are talking of passenger equipment, therefore the primary consideration becomes that of increasing the number of passengers using our facilities. In the study of other railroads using Diesel equipment, we found that, even when schedule times were not reduced, traffic increased when Diesel locomotives were used. In our particular case, engineering data assured us we could reduce our running time between Richmond and Miami approximately three hours and between Miami and Richmond approximately four hours. With this new schedule

and Diesel equipment, and an increase of two cars per train, we naturally anticipated some increase in business.

Our engineering studies also indicated that our operating costs on this new reduced-time schedule should not increase; on the contrary all indications were that these costs should be reduced. Engineering data we can reasonably rely upon, but increase in passengers and revenue is, naturally, problematical.

The analysis of the 1938-39 season, as compared with 1937-38 shows an increase in passengers of 64.2 per cent. The operating costs to the railway were substantially reduced.

The popularity of Diesel locomotives in passenger train service throughout the territory served by the Seaboard is unquestioned and even though they have now been in service slightly over one year, the interest of the traveling public and employees alike shows no sign of abating. This, in my opinion, is due to several reasons, some of which I shall mention briefly as follows:

(1) Safer operation, due to perfect visibility from the engineer's comfortable station at the extreme front of the locomotive and to his easy access to all vital operating devices—such as throttle, air brake, whistle, bell, etc.

(2) Smoother handling. Because of the electric transmission on these locomotives, the full horsepower is available for starting and at the lower speeds, which means that they are much better able to start heavy trains smoothly and rapidly. This advantage of the Diesel locomotive also enables it to ascend grades more rapidly and makes it unnecessary to run at excessive speeds on descending grades; all of which tends to make for higher sustained speed, resulting in more satisfactory train handling.

(3) Cleanliness. Elimination of smoke, soot and cinders common to steam power.

There are some other interesting facts concerning the operation of this equipment which I would like to include. Our decision to purchase Diesel equipment was made at the time the builder (Electro-Motive Corporation, La Grange, Ill.) was changing models. New engines were available and also new electrical transmission equipment. This equipment had not been placed in service when our order was entered, therefore, when our nine 2,000 hp. units were delivered, they were the first of their model, and the builder naturally anticipated some minor troubles. Our railway, therefore, became more or less an actual laboratory for the proving of this equipment. The builder sent several men to stay and correct any defects that might have crept into the equipment during design and manufacture, which only actual use in service would bring to light. As anticipated, certain minor corrections were made, the expense being assumed by the builder. Their service men remained with us for several months.

Prior to the delivery of the equipment, we sent eight of our shopmen to the builder's training school. These men received fundamental training but naturally they were not sufficiently qualified to cope with all problems of actual service. Having worked with the builder's service men, our men are now better qualified to cope with any operating problems. As a result, we believe future maintenance should be reduced.

Our experience with Diesel equipment has been such that we have entered an order for nine additional 2,000 hp. units, which will permit us to extend the use of Diesels to the West Coast Orange Blossom Special between Washington, D. C. and St. Petersburg, Fla., the coming winter season. This will be a 12-car train, operated with 2 units, replacing steam power. With this new equipment, we are reducing the schedule 1½ hours as compared with last season.

Plans for the operation of the East Coast Orange Blossom Special provide for the use of three units per locomotive (6,000 hp.), the same as last winter, but for an increase from 15 cars to 16. The weight of this train will be 647 lb. per hp. Fuel consumption will be approximately 4 gallons per train-mile; according to our present performance, 17.6 miles per gallon of lubricating oil will be obtained.

Conclusion

Up to this point I have been referring to conventional Pullman car trains which are, or will be, handled by Diesel locomotives. I should now like to say a few words about our Silver Meteor which, since last February, has been running every third day from New York to Miami and St. Petersburg, Fla. The Silver Meteor is a seven-car, stainless steel, de luxe coach train, weighing 528 lb. per hp. This train splits at Wildwood, Fla., a portion going to Miami, the remainder to St. Petersburg. Northbound, the train is again consolidated at Wildwood and continues to New York. The motive power used between Washington and Miami is only one 2,000 hp. Diesel unit, acquired last February for this train. Figures for the first seven months show an average fuel consumption of 1.3 gallons per train-mile while 54.7 miles were obtained per gallon of lubricating oil. The run between Wildwood and St. Petersburg is protected with one 600 hp. unit.

With the purchase this Fall of more Diesels and two additional stainless steel, de luxe coach trains, we shall have daily service (beginning about December 1) with the Silver Meteor between New York and Miami and service every third day between New York and St. Petersburg, Fla. The schedule will be 25 hours or less between New York and Miami and 24 hours or less between New York and St. Petersburg.

Our experience with Diesel locomotives has proved satisfactory. We would not have increased our Diesel fleet had we harbored doubt that economy and efficiency would be obtained. Perhaps our confidence in the dependability of this equipment will be impressive when I explain that not a Diesel unit now owned or on order is for stand-by protection. We have a regular and definite assignment in view for every unit.

Discussion

W. G. Knight (Bangor & Aroostook): While we have no Diesels we have followed the improvements of the Diesel. However, we have a problem that is peculiar to our line. We use the most powerful switching locomotives in New England, except such Mallet types as are used in hump service. These locomotives not only do heavy switching but are used as pushers about one-fourth of the time. The grades over which these locomotives operate are semi-momentum, that is, a fairly high speed must be obtained at the foot of the grade.

In acquiring these speeds the principal engine with a fairly large wheel develops a high horsepower while the steam switching engine with smaller wheels increases its developed horsepower up until it reaches a piston speed of 1,000 feet per minute. This is never attained, however, in our service.

If we were to use a Diesel to perform this service, a study of the horsepower curves would show a decided reduction of available horsepower within the operating ranges and, of course, a higher demand on the leading engine, which could not move the train load over the grade because of the lower horsepower output of the Diesel in the higher ranges of speed.

For all switching speeds up to 6 m.p.h. a 1,200-hp. Diesel electric locomotive delivers higher torque and can

accelerate maximum tonnage more rapidly than can a steam locomotive of 2,100 hp. Its superiority over a steam locomotive of 1,500-hp. extends to a speed of 7 m.p.h. and over a 1,300-hp. steam locomotive to 11 m.p.h. The corresponding Diesel advantages at low speeds over steam characteristics in much larger locomotives are apparent both in 900-hp. and 600-hp. Diesels.

The real reason for the use of Diesel locomotives is that of their cost of operation. Such locomotives may have a better appearance, may be cleaner, and their characteristics may be an improvement over those of steam motive power, but, unless they save money, they will not be used. Fortunately, operating statistics are now available which bear out the predictions of the designers that their operation is more economical than that of steam, and especially is this true of switching locomotives when used for switching service only.

E. G. Ringberg (B. & M.): The Diesel engine has made rapid inroads into the field of railroad transportation and particularly in switching and yard service. In turning to the new equipment pages of the weekly issues of the Railway Age and other railroad publications, one seldom sees any reference to the conventional 0-6-0 and 0-8-0 steam switching locomotives. Today most railroads are buying Diesel-electric locomotives of 600 hp. and up for switching service.

Under most operating and fuel conditions, the steam switching locomotive must be removed from service earlier than necessary and must go to the nearest engine house for servicing. This means added expense, delays, and the accumulation during the life of the locomotive of considerable unproductive mileage between the enginehouse and classification yard or point of switching. The oil-electric switching locomotive has today practically an 85 to 90 per cent. and upward availability factor which means that the engine can be utilized nearly the full 24-hr. day without serious interruption. Inspection and other required attention can be rendered during the crew's lunch periods and refueling can be readily accomplished providing such facilities are conveniently located.

Inherent in the speed-horsepower curve of the oil-electric engine itself is the ability of the unit as a whole to give constant maximum horsepower throughout the normal operating speeds for which the engine is designed, whereas in the steam locomotive, either for switching or road service, maximum horsepower must be associated with a single specified speed or within a narrow range of specified speeds usually well above normal switching requirements. This characteristic is a decided advantage for switching, particularly for heavy-tonnage, long-grade operations and the only limitation is the ability of the electric transmission to carry the heavy currents for the required period of time.

In the Diesel engine we have excellent visibility which cannot possibly be reproduced in the steam locomotive. Low fuel costs and low standby costs are made possible through the burning of low-grade fuels and the facility of shutting off the engine completely during long waiting periods. Reduced maintenance costs are becoming more and more favorable for the oil-electric locomotive as increased number of units are placed in operation. We have also short wheel bases and the unit carries its own fuel which adds weight, improves adhesion, and eliminates the necessity of trailing a tender with coal and water. Last but not least, Diesel locomotives eliminate the smoke nuisance around congested and city areas which is always a source of contention among public authorities. The railroads are trying many devices on steam locomotives in the interest of smoke abatement and some success has been gained in this direction.

In both passenger and freight service, particularly in passenger service, the oil-electric locomotive is rapidly finding its place in lightweight, high-speed, streamline trains, such as the Orange Blossom Special operated by the Seaboard Air Line Railroad. The success of these operations is a matter of economics and the more of these units we build and the wider their scope of operation, the sooner will we accumulate more definite statistics which may or may not confirm our findings and hopes of today.

One of the advantages of Diesel locomotive operation in road service is the elimination of the hammer blow on the driving wheels, which on the steam locomotives is a factor detrimental not only to the locomotive itself but to the roadbed and bridge structures over which they travel. The driving wheels of a Diesel locomotive can be statically and dynamically balanced and smooth torque and rotation is insured. This is not always possible in a steam locomotive, particularly on freight locomotives where small driving-wheel diameters are involved and only a small percentage of the reciprocating weights can be counterbalanced.

I am not attempting to convey the idea that the oil-electric locomotive will in the future, completely supplant the steam locomotive in road service. The oil-electric locomotive as far as capacity is concerned, cannot accomplish any more than the steam locomotive and there are a good many factors still favorable to steam locomotive operation. The steam locomotive is going through stages of developments in the field of high-pressure boilers, improved steam distribution, economy devices and lately the turbo-electric locomotive is making a bid. In the final analysis, in my opinion, it will be a matter of arithmetic in economics; and the designs that will give speed, comfort, luxury and safety most economically, will survive.

E. K. Bloss (B. & M): While our largest Diesel-operated train is a three-car train and while our greatest horsepower in one unit is 800, we actually are operating about 11,000 hp., and so far we have operated about 3,000,000 miles. That should give us a background on which to decide whether Diesels are any good or not.

The Diesel-electric lends itself beautifully to switching service. On the other hand, when it is put into switching service, it is a wheelbarrow. There is no glamor; no romance. And you have one fine time trying to get the tools and parts that Mr. Roy says are necessary for these Diesel engines when you put them into this wheelbarrow service. If you could paint them bright orange and lavender and stretch them out to 6,000 hp., you could get get some of the things you want. But when you put them out in a freight yard, they are just another thing out in the freight yard and to be really useful you ought to be able to fix them with a piece of bailing wire and an alligator wrench.

As to road engines, I think one point that should be mentioned, is the fact that unless a road engine, which costs a lot of money, can be used most of the time, it does not justify itself economically. In order to use it a substantial portion of the time, you have to run it a lot of miles. The round trip that Mr. Roy told us about is 2,290 miles. We have done a lot of figuring in the last five years, since we got the Flying Yankee, to determine where we could get another run that involved as much as 735 miles.

That is a problem here in this congested territory, and I think a good many people who just give it casual consideration, feel that we are slipping behind. Don't forget that the Flying Yankee was the second Diesel-powered train. We were right in the game at the beginning. Then everybody else plowed into it and went away

ahead of us, and now we have roads with nine 2,000-hp. locomotives. We could go ahead with them, too, if we only had some place to run them. (Applause.)

K. Cartwright (N. Y. N. H. & H.): There is one statement in Mr. Roy's paper that is absolutely true, and I believe it is the principal reason for the rapid spread of the Diesel-electric locomotive in main-line passenger service.

Mr. Roy said that one of the reasons why they chose the Diesel for this service on the Seaboard was the public appeal. The proponents of the Diesel locomotive have done a 100 per cent job in selling the Diesel locomotive to the public. I believe that to the general public today the Diesel locomotive is synonymous with speed, power, comfort and smooth riding. I am afraid that our steam locomotive friends have been a little bit asleep at the switch in that respect.

I do feel, however, that a modern, well-designed steam locomotive will compare very favorably with a Diesel on runs up to approximately 1,000 miles. There is no question that there is a very definite field for the Diesel in main-line passenger service when you get into long runs where a steam locomotive has to be taken off the train, serviced, the fire cleaned, and so forth. The Diesel can be refueled en route and go right through.

Unless you have a particularly bad grade of coal on a modern steam locomotive, there is no trouble in making runs of 800 to 1,000 miles.

I have been trying for a long time to find out what it costs to maintain a Diesel locomotive of 4,000 hp. in main-line passenger service, and I have not yet been able to find that out.

Last June, at the annual meeting of the A. A. R., Mechanical Division, in discussing the report on Diesel-electrics, a few of the men started to take their hair down and tell the truth, but they stopped before they got very far.

We haven't any direct comparison to go by on the New Haven. The only thing we can say is this: We have a Diesel train, the Comet; an 800 horsepower unit. This morning I jotted down some figures. It so happens that we have some new steam locomotives on the New Haven with a nominal horsepower of about 3,800. It is a coincidence that those steam locomotives make a yearly mileage which is very closely comparable to the yearly mileage of this Diesel train.

In the first year's operation of the Diesel train, when it made 133,000 miles, the maintenance cost of the power plant and motor trucks was 9.5 cents a mile. The first year's operation of one of these new steam locomotives, when it made 131,000 miles, showed a maintenance cost for the steam locomotive of 8.0 cents a mile. And that was a 3,800-hp. locomotive against an 800-hp. Diesel.

When the Diesel train got up to 260,000 miles in the second year's operation, the cost of maintaining the power plant was 11.1 cents a mile. The maintenance cost of the steam locomotive, with similar mileage, was 9.4 cents a mile.

In the third year's operation of the Diesel train, with 395,000 miles, the cost was 12.7 cents a mile. The steam locomotive has not been in service long enough to reach that mileage, but the cost curve projected looks as if it would be about 11.8 cents a mile when it gets up to that approximate mileage.

I am certain that if we had a 4,000-hp. Diesel in main-line passenger service on the New Haven between New Haven and Boston, which would be required to do the work that these steam locomotives do, it would cost us considerably more to maintain that than it costs to maintain a steam locomotive.

I do not mean to say that the Diesel locomotive is going to cost more to maintain than the steam locomotive in all cases, but I want to point out that the popular conception with regard to the Diesel locomotive is a mistake. Its operation is very definitely a question of economics and operating conditions. Although there are many cases where the Diesel gives an ideal solution, I believe there are just as many cases where the steam locomotive, for a long time to come, will prove the equal of the Diesel.

Prof. W. J. Cunningham (Harvard Univ.): I understand it to be a fact that on a horsepower basis a Diesel locomotive costs four times as much as a steam locomotive. On the horsepower basis, that means four times as much interest, four times as much depreciation, and we do not know yet what the depreciation is. The Diesel has not gone through a cycle of life, and we have not any mortality table on which to base a rate of depreciation.

Old man economics comes into this and, while there isn't any doubt whatever about the advantages which Mr. Roy has stated for the Diesel, its high availability for service and the many conveniences that go with it, better riding qualities, less stress in the track, we have not had an answer yet as to what those advantages cost as compared with steam.

Mr. Bloss referred to the Diesel switchers. I know in a specific case that the Diesel doesn't stand any show whatever in comparison with steam locomotives unless they can be used at least two switching shifts a day. You have to have 16 hours of service in order to take care of the higher first cost, that first cost involving the interest charges and depreciation.

That is the thing that stares those in the face who have to pass on the policy as to whether or not a Diesel shall be employed. Many people say that the New Haven is old fashioned, that it ought to have Diesel trains between New York and Boston. But I am doubtful that they can support a proposition of that kind with a true recognition of all of the economic factors. They have not yet figured it out. Maybe they will some time. You couldn't get enough operating mileage between New York and Boston to justify it. If I understand Mr. Bloss correctly, he cannot find another place where the Flying Yankee could make 700 or 800 miles per day.

I think that motive power men should give more attention to the economic side. Because I have been representing the savings banks and the bondholders in the New Haven reorganization, I have to think more about the economics of the situation.

Mr. Roy: The answer to you, Professor Cunningham, so far as the Seaboard is concerned, is that these locomotives have now made over 200,000 miles. The engine that was bought last February for the Silver Meteor, has made 185,000 miles up to September 1 and has been out of service 10 days.

Of course, we have only had these Diesels for approximately a year, and they have made 1,902,000 miles. The maintenance cost per mile from December, 1938, to September, 1939, is 6 cents. The operating cost per mile between December, 1938 and September, 1939, is 8.3 cents, which makes a total of slightly over 14 cents per mile.

A. W. Munster (B. & M.): There are just two things that I would like to emphasize—I feel that Mr. Bloss failed to emphasize as strongly as he should the necessity for proper shop facilities and tools for the maintenance of Diesels, whether they are switch or road engines. Furthermore, emphasis should be laid on the necessity for an organization with sufficient training for men who are responsible for keeping Diesels in service.

(*Continued on page 533*)

Designing for

High Tensile Steels*

By H. M. Priest†

This paper presents data on buckling and elastic stability of thin flat plates and provides the designer with a working basis for meeting the present-day problems arising in light-weight construction

Elastic Stability

THE advent of high-tensile steels into modern structures has raised important problems for engineers in dealing with the buckling tendencies, or elastic instability of thin flat plates. This subject has been extensively studied by the aircraft industry and a very considerable literature is to be found in the Technical Notes and Memoranda of the National Advisory Committee for Aeronautics. The book by S. Timoshenko, entitled Theory of Elastic Stability, is an invaluable aid to any engineer who is deeply concerned with design problems in light-weight construction.

The approach to problems of stability is that of determining the critical load or unit stress at which buckling is imminent. It is not the intent of this paper to discuss the fundamental derivations but rather to present some of the resulting formulas, together with charts and diagrams, that will be of practical assistance to engineers.

The buckling of a flat plate, forming a component part of a member, (in contrast with buckling of the entire member), does not necessarily mean failure. As will be explained in the next section, the buckled portion of the plate may be considered as ineffective while the remainder of the member continues to carry increasing loads. The problem, therefore, divides into two parts: (1) The preventing of any buckling by determining the critical load at which buckling is imminent; (2) The permitting of local buckling and the determination of the maximum load which the remaining effective portions of the member can carry. The selection of one of these two methods to be followed in a specific design will depend upon the structure and the need, because of appearance, for preventing any buckles. Elastic instability will be encountered most frequently in flat plates subjected to edge compression or shear. The next two sections will treat of these conditions.

Stability of Flat Plates in Edge Compression

Several factors affecting the buckling stability and ultimate strength of flat plates in compression make it difficult to lay down precise rules of design. The edge supports of the sheets are very important; initial lack of flatness may lower the critical stress values, and the permitting of a certain amount of buckling will modify the design. It becomes necessary for the engineer to estimate the conditions applying to his structure and then to select the appropriate formulas.

Fig. 10 illustrates several types of edge supports. Sketch (a) is representative of simply-supported edges. To be sure, neither is a practical joint, but they have been used in many tests to provide freedom of rotation about the longitudinal axes of the edges, while maintaining the edges in alignment. Sketch (b) represents a fixed-edge condition in which rotation is prevented. In actual practice, the edge supports of flat plates come within these two extremes, unless the edge is unsupported, or free. Sketch (c) shows several cross-sections made up of flat surfaces with designations of the type of edge supports commonly assumed in designing.

The original investigation of stability of flat plates was made by G. H. Bryan and presented in the Proceedings of the London Mathematical Society, 1891. Mr. Timoshenko gives the following theoretical formula for the critical buckling stress in a flat plate under edge compression:

$$S_{cr} = \frac{K \pi^2 E}{12(1-m^2)} \times \frac{t^2}{b^2} \quad \ldots\ldots\ldots\ldots\ldots (28)$$

S_{cr}—Critical unit compressive stress at which buckling is imminent, lb. per sq. in.
E—Modulus of elasticity, lb. per sq. in.
m—Poisson's ratio.
a—Length of plate, in.
b—Width of plate, in.
t—Thickness of plate, in.
K—Constant, depending upon ratio of a/b and condition of edge supports.

With $m = .30$ for steel

$$S_{cr} = \frac{.9038\ KE}{(^b/_t)^2}$$

For simply-supported edges, the minimum value of K is 4.0 and is usually applied for all values, of a/b. Similarly, the value of K for fixed edges is 7.0. Using $K = 4.0$,

$$S_{cr} = \frac{3.615\ E}{(^b/_t)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (29)$$

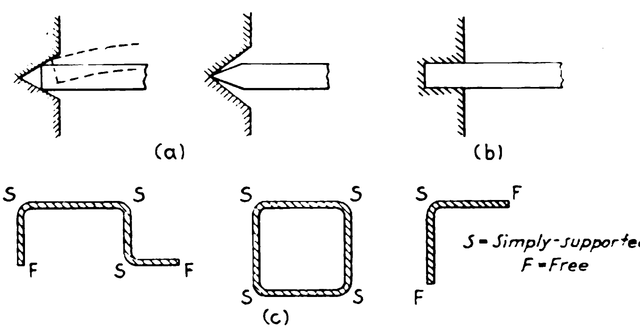


Fig. 10—Flat plates under edge compression

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* Parts I and II of a previous paper by the same author, entitled Designing for High Tensile Steels, were published in the May and June, 1936, issues, respectively, of the *Railway Mechanical Engineer*. This paper will be published in two part, designated as Parts III and IV, Part III appearing in this issue and Part IV to appear in a later issue. For reference purposes, the numbering of formulas, tables, and illustrations is continued from Part II.

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It was pointed out in Part I in deriving Formula (4) that tests on column web plates and wide web columns conducted at the U. S. Bureau of Standards had shown the actual critical stresses to be about 75 per cent of those given by Formula (29). Inserting this percentage,

$$S_{cr} = \frac{2.712\,E}{(^b/_t)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (30)$$

Rearranging Formula (30),

$$^b/_t = \sqrt{\frac{2.712\,E}{S_{cr}}} = 1.647 \sqrt{\frac{E}{S_{cr}}}$$

which is Formula (4). For a particular value of the critical unit stress, S_{cr} the ratio $^b/_t$ is the limit at which buckling is imminent. The width b as determined from this formula, is sometimes referred to as the "effective width" or the maximum width at which buckling is imminent at the stated critical unit stress. S_{cr} is often taken as the yield-point stress of the material, but may be, for example, the ultimate stress of a column.

An interesting application of Formula (30) came to the author's attention during the repairs on the center sills of some gondola cars. The cross-section of the sills is shown in Fig. 11. It was rather striking that the corrosion of the cover plates was most serious along the center line of the sills. For the covers,

$$^b/_t = \frac{17.375}{0.25} = 69.5$$

$$S_{cr} = \frac{2.712 \times 29{,}000{,}000}{69.5 \times 69.5} = 16{,}280 \text{ lb. per sq. in.}$$

The critical buckling stress is so close to the probable working stress with the ¼-in. plate that any reduction

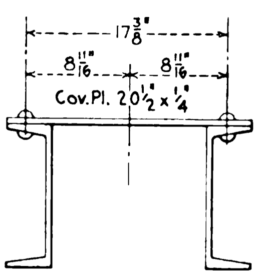


Fig. 11—Buckling stability of center sill cover

of thickness through corrosion over a period of years might well result in actual buckling. This action would flex the plate along the center line, loosening scale and so promote further corrosion. It seems reasonable that this analysis explains the cause of the particular failure of these cover plates.

If the thickness of the cover plate were to be increased, the critical unit stress would be as shown below:

t	$^b/_t$	S_{cr}
5/16	55.60	25,440
3/8	46.33	36,640

Should the value of S_{cr} exceed the yield point of the material, then the yield point is the critical buckling stress.

Returning to Formula (29) and solving for the value of $^b/_t$ we have

$$^b/_t = 1.90 \sqrt{\frac{E}{S_{cr}}} \quad \ldots\ldots\ldots\ldots\ldots (31)$$

Another investigation at the U. S. Bureau of Standards[7] showed that the constant 1.70 agrees more closely

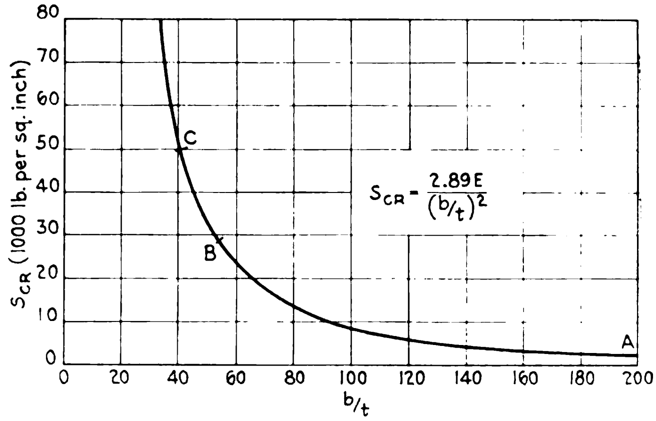


Fig. 12—Critical buckling stress under edge compression

with test results than does the theoretical value of 1.90. Then

$$^b/_t = 1.70 \sqrt{\frac{E}{S_{cr}}} \quad \ldots\ldots\ldots\ldots\ldots (32)$$

$$S_{cr} = \frac{2.89\,E}{(^b/_t)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (33)$$

It will be noted that these two formulas do not differ materially from those based upon the column tests at the Bureau of Standards. Formulas (32) and (33) will be used in the subsequent discussion, because they are of frequent occurrence in the literature dealing with the buckling of flat plates.

Fig. 12 is a plot of Formula (33). The formula is only applicable so long as the value of S_{cr} is less than the yield-point stress of the material, since the yield-point stress is the maximum which the plate can sustain. The portion of the curve between points A and B is applicable for a steel having a yield point of 29,000 lb. per sq. in. and likewise the curve between points A and C is valid for a steel with a yield point of 50,000 lb. per sq. in. It is the usual practice to provide a smooth transition from the curve to the horizontal limits at the yield points. A method of accomplishing this will now be explained.

Fig. 13 is a curve of the unit stress S for various values of the ratio $^b/_t$. It is composed of two parts, the first represented by the formula: $S = F - N\,(^b/_t)^2$ and the second part given by the formula:

$$S = \frac{KE}{(^b/_t)^2}$$

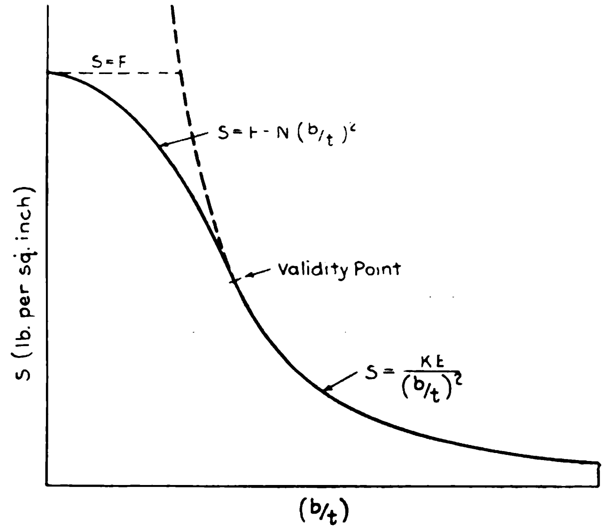


Fig. 13—Development of buckling formulas

[7] See Technical Report No. 356, National Advisory Committee for Aeronautics.

The two curves are tangent at the point designated as validity point and, of course, the value of S at this point is the same in either formula. These conditions lead to the value of

$$N = \frac{F^2}{4KE}$$

and it will be found that at the validity point.

$$S = \frac{F}{2} \text{ and } {}^b/_t = \sqrt{\frac{2\,KE}{F}}$$

If $S = S_{cr}$ and $K = 2.89$ we have

$$S_{cr} = \frac{2.89\ E}{({}^b/_t)^2}$$

which is Formula (33).

Since the maximum S_{cr} is the yield-point stress we may let F = yield-point stress. From the formula $S = F - N\ ({}^b/_t)^2$ we have $S = F$ = yield-point stress when ${}^b/_t = O$. N is a constant which brings the two parts of the curve into tangency. For a steel with a yield point of 50,000 lb. per sq. in. we have:

$$N = \frac{50{,}000 \times 50{,}000}{4 \times 2.89 \times 29{,}000{,}000} = 7.457$$

$$S_{cr} = 50{,}000 - 7.457\ ({}^b/_t)^2 \ldots\ldots\ldots\ldots (34)$$

At the validity point

$${}^b/_t = \sqrt{\frac{2 \times 2.89 \times 29{,}000{,}000}{50{,}000}} = 57.90$$

$$S_{cr} = \frac{2.89 \times 29{,}000{,}000}{({}^b/_t)^2} = \frac{83{,}810{,}000}{({}^b/_t)^2} \ldots\ldots (35)$$

Formulas (34) and (35) give the critical buckling unit stress and the values of S_{cr} must be divided by the factor of safety. Assuming a factor of safety equal to 1.80, the working unit stresses will be given by the following formulas:

$$S = 27{,}780 - 4.143\ ({}^b/_t)^2 \ldots\ldots\ldots\ldots (36)$$

$$S = \frac{46{,}560{,}000}{({}^b/_t)^2} \ldots\ldots\ldots\ldots (37)$$

Similarly, the formulas for a steel having a yield point of 29,000 lb. per sq. in. are:

$$S_{cr} = 29{,}000 - 2.509\ ({}^b/_t)^2 \ldots\ldots\ldots\ldots (38)$$

$$S_{cr} = \frac{83{,}810{,}000}{({}^b/_t)^2} \ldots\ldots\ldots\ldots (39)$$

with the validity point at ${}^b/_t = 76.03$.

Using a factor of safety = 1.80, the formulas for working unit stresses become:

$$S = 16{,}110 - 1.394\ ({}^b/_t)^2 \ldots\ldots\ldots\ldots (40)$$

$$S = \frac{46{,}560{,}000}{({}^b/_t)^2} \ldots\ldots\ldots\ldots (41)$$

When the edges are fixed by the supports the theoretical minimum value of K is 7.0 in formula (28). Adequate tests are lacking from which to compare actual and theoretical values of the constant, but the same reduction for the actual value may be assumed as was obtained in the case of simply-supported edges.

$$S_{cr} = \frac{7.0 \times \pi^2 \times E}{12\,(1-.09)\ ({}^b/_t)^2} = \frac{6.327\ E}{({}^b/_t)^2} \ldots\ldots \quad (42)$$

The coefficient in Formula (29) was reduced from 3.615 to 2.890 in Formula (33). Applying this reduction, the coefficient in Formula (42) becomes $6.327 \times 2.89 \div 3.615 = 5.058$. Then the actual critical buckling unit stress is given by the formula

$$S_{cr} = \frac{5.058\ E}{({}^b/_t)^2} \ldots\ldots\ldots\ldots (43)$$

from which

$${}^b/_t = 2.249 \sqrt{\frac{E}{S_{cr}}} \ldots\ldots\ldots\ldots (44)$$

By the application of the methods explained for simply-supported edges, using a factor of safety equal to 1.80 the following formulas for working unit stresses may be obtained for a yield point of 50,000 lb. per sq. in.

$$S = 27{,}780 - 2.367\ ({}^b/_t)^2 \ldots\ldots\ldots\ldots (45)$$

Validity limit at ${}^b/_t = 76.60$

$$S = \frac{81{,}490{,}000}{({}^b/_t)^2} \ldots\ldots\ldots\ldots (46)$$

It becomes a matter of judgment as to the degree of restraint imposed upon the edges of the flat plate by the supports. For average conditions, a value of $K = 5.0$ in Formula (28) might be a reasonable assumption.

Another case of frequent occurrence is that in which one edge is free while the other three edges are simply supported, two of which are loaded, such as the outstanding flanges of compression members. The theoretical minimum value of K in Formula 28 is 0.456.

This gives

$$S_{cr} = \frac{0.411\ E}{({}^b/_t)^2} \ldots\ldots\ldots\ldots (47)$$

Test results have shown that the coefficient in Formula (47) is more nearly equal to 0.385 in actual practice, making the critical buckling unit stress

$$S_{cr} = \frac{0.385\ E}{({}^b/_t)^2} \ldots\ldots\ldots\ldots (48)$$

and

$${}^b/_t = .620 \sqrt{\frac{E}{S_{cr}}} \ldots\ldots\ldots\ldots (49)$$

Again, suitable working unit stresses can be worked out by the methods illustrated in Fig. 13. Using a factor of safety = 1.80 for illustrative purposes and a yield point of 50,000 lb. per sq. in.

$$S = 27{,}780 - 31.10\ ({}^b/_t)^2 \ldots\ldots\ldots\ldots (50)$$

Validity limit at ${}^b/_t = 21.13$

$$S = \frac{6{,}203{,}000}{({}^b/_t)^2} \ldots\ldots\ldots\ldots (51)$$

All of the formulas, so far given, have been based upon the determination of the critical unit stress at which buckling is imminent. It was mentioned at the end of the previous section that alternative No. 2 can be followed in designing practice. This method has been fully explained in an article, entitled The Strength of Thin Plates in Compression, by Karman, Sechler and Donnell in the Applied Mechanics Division, Transactions of the American Society of Mechancial Engineers, January, 1932. Tests at the U. S. Bureau of Standards showed that the ultimate load in edge compression was independent of the width and length of the plate and approximately proportional to the square of the thickness.

The method makes use of these facts by considering the load to be carried on strips adjacent to the edge supports having a width w, as indicated in Fig. 14. When two edges are supported, the effective width of the plate is $2w$ and is made equal to the value of b in such formulas as (32) and (44). With one free edge, the effective width is w and is made equal to b in Formula (49). In both cases S_{cr} equals the yield point stress

of the plate material. The ultimate load P equals the yield point $\times$ the effective width $\times$ the thickness t.

For example, take a plate with simply-supported edges which has a width, $b = 6$ in. and a thickness, $t = .05$ in.

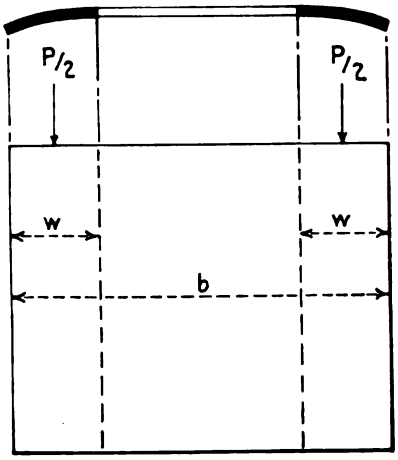


Fig. 14—Effective width of plate under edge compression

Assume the steel in the plate to have a yield point of 50,000 lb. per sq. in. First, let a formula be derived for P. From Formula (32).

$$b = 1.70\, t \sqrt{\frac{E}{S^{cr}}} = 2w$$

$$P = S^{cr} \times 1.70\, t \sqrt{\frac{E}{S^{cr}}} \times t = 1.70\, t^2 \sqrt{E\, S^{cr}} \ldots (52)$$

Placing the assumed values of t and S_{cr} in the formula with $E = 29{,}000{,}000$ lb. per sq. in. $P = 5{,}120$ lb.

It will be interesting to compare this value of the ultimate load with the critical buckling load. From Formula (33).

$$S^{cr} = \frac{2.89 \times 29{,}000{,}000}{(^6/_{.05})^2} = 5{,}820 \text{ lb. per sq. in.}$$

$$\text{Critical Load} = 5.820 \times 6 \times .05 = 1{,}746 \text{ lb.}$$

This illustrates the difference in the two methods of designing flat plates in members and emphasizes the point that initial buckling of the plate does not end its load-carrying ability.

Whenever stiffeners are added to a flat plate to increase its carrying capacity in edge compression, the problem arises as to the effective width of plate or sheet which may be included as a part of the stiffeners. A method of arriving at this combination of stiffeners and effective area of plate has been proposed by E. E. Lundquist in Technical Note No. 455 of the National Advisory Committee for Aeronautics.

The method assumes the stiffeners and the effective area of the plate to act together as a column, the radius of gyration of which is that of the combination about an axis parallel to the plate. Let Fig. 15 represent a flat plate in edge compression having several stiffeners of arbitrarily selected forms for illustrative purposes. Dimensions b_1 and b_7 are the widths of outstanding portions of the plate having one edge free and the other simply supported. Dimensions b_2 to b_6 inclusive are the widths between the simply-supported edges of intermediate portions of the plate. The effective widths w_1 to w_7 are determined from the general formula

$$w = Ct \sqrt{\frac{E}{S^{cr}}} \ldots\ldots\ldots\ldots\ldots\ldots (53)$$

The table in Fig. 15 gives the value of the constant "C" and also the maximum limiting value of the width. It is evident, for example, that if the value of w_2 is found by the formula to be greater than one-half of b_2 there would be an overlapping of areas if the calculated value of w_2 were to be used. Hence $b_2/2$ is the maximum value of w_2.

The value of C for w_1 and w_7 will be recognized as the one used in Formula (49) for plates having a free edge. Likewise, the value of C for w_2 to w_6 is equal to one-half of the constant 1.70 in Formula (32).

The value of S_{cr} is sometimes taken as the yield point strength of the material, although it is also taken as equal to the ultimate unit stress of the column in compression. The latter unit stress may be found from such formulae as are given in Tables V and VI in Part I, by multiplying the values of P/A by the factor of safety of 1.80 which was the basis of determining these working formulas. When the column ultimate unit stress is used, it will probably require several adjustments of the effective width until the actual stress on the combination of stiffener and plate equals the stress given by the column formula.

Stability of Flat Plates in Shear

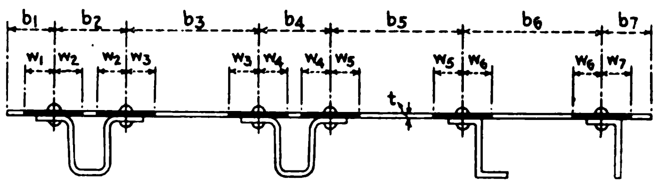
It is demonstrated in every textbook on applied mechanics that in a plate subjected to shear there are two inclined sections at right angles to each other upon which the stresses are respectively tension or compression. The stability of the plate against buckling depends upon the compressive stress and when this stress reaches a critical value, buckling takes place in the manner familiar to all engineers. A formula can be derived for the critical shearing unit stress (which is a direct measure of the critical compressive unit stress) and Mr. Timoshenko gives the following formula in his book, Theory of Elastic Stability.

$$S^{cr} = \frac{K \pi^2 D}{B^2 T} \ldots\ldots\ldots\ldots\ldots\ldots (54)$$

in which S^{cr} = critical shear in lb. per sq. in.

at which buckling is imminent. The significance of the terms B, D, and T are those given in the chart for shear buckling in Fig. 16.

Formula (54) gives the critical shear in lb. per sq. in. Since the shear per inch of length of the edge is always



$$\text{Effective width } w = Ct \sqrt{\frac{E}{S^{cr}}}$$

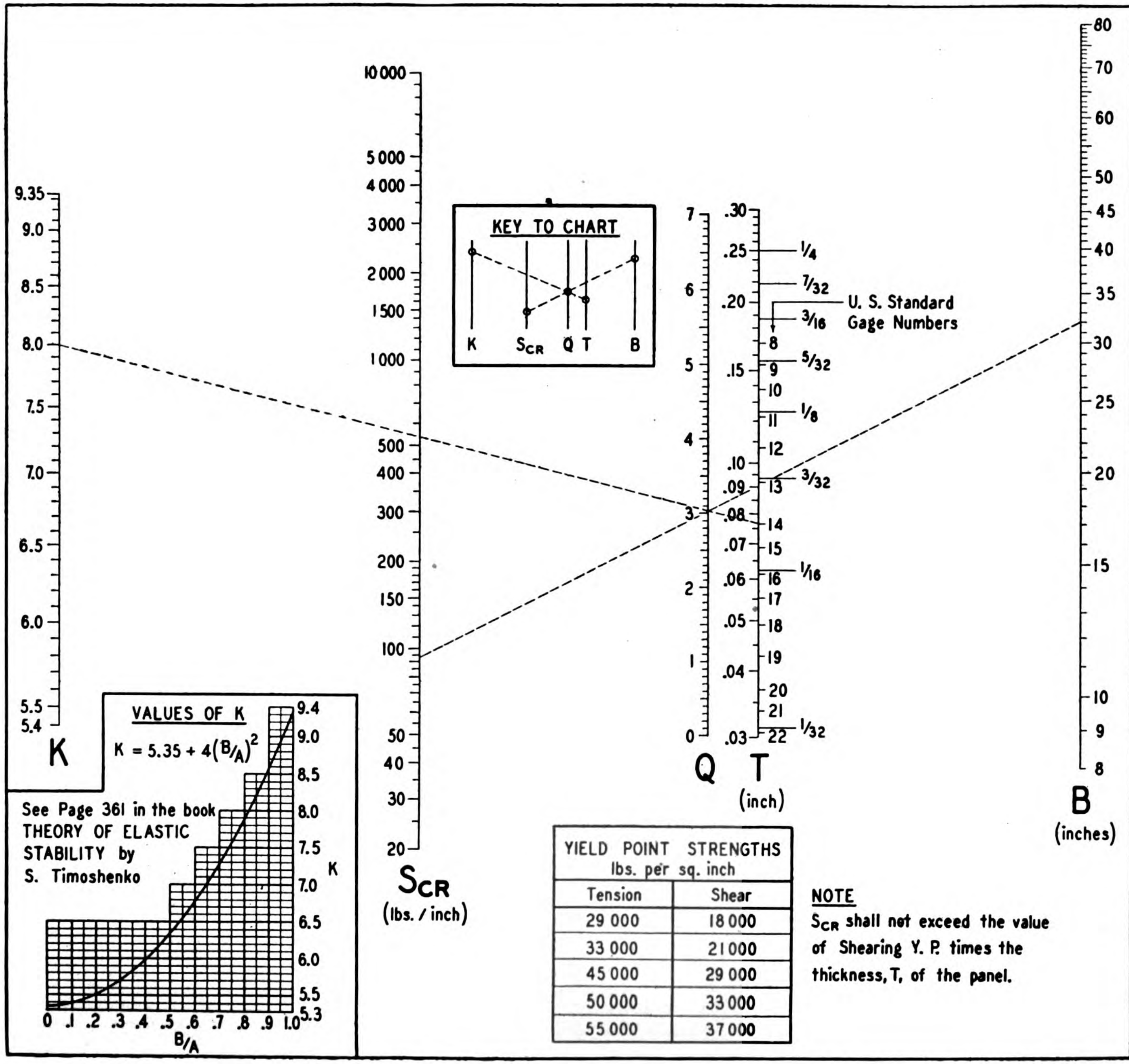
Effective width	Coefficient C	Maximum width
w_1	.62	b_1
w_2	.85	$\frac{1}{2}\, b_2$
w_3	.85	$\frac{1}{2}\, b_3$
w_4	.85	$\frac{1}{2}\, b_4$
w_5	.85	$\frac{1}{2}\, b_5$
w_6	.85	$\frac{1}{2}\, b_6$
w_7	.62	b_7

Fig. 15—Effective width of plates in combination with stiffness

known in the course of designing, it will facilitate the computations if Formula (54) is converted to give the critical shear per inch, by dividing by the thickness, T. We then obtain

$$S^{cr} = \frac{K \pi^2 D}{B^2} \ldots\ldots\ldots\ldots\ldots\ldots (55)$$

in which S^{cr} = critical shear per in.



YIELD POINT STRENGTHS lbs. per sq. inch	
Tension	Shear
29 000	18 000
33 000	21 000
45 000	29 000
50 000	33 000
55 000	37 000

NOTE

S_{CR} shall not exceed the value of Shearing Y. P. times the thickness, T, of the panel.

LEGEND

A

Thickness = T

B

$A \geq B$

$$S_{CR} = K\frac{\pi^2 D}{B^2}$$

S_{CR} = Critical Shear per inch at which buckling will occur.

A = Length of Panel (inches)

B = Width of Panel (inches)

$$D = \frac{E\,T^3}{12(1-m^2)}$$

E = Modulus of Elasticity 29 000 000 lbs. per sq. in.

m = Poisson's Ratio = 0.3

K = Constant, dependent upon B/A

T = Thickness of Panel (inch)

EXAMPLE

Assume A = 39.3″ B = 32″ T = 14 ga.

B/A = .814 From the Chart, K = 8.00

Lay straight edge across chart from K = 8.00 to T = 14 ga. Read intersection on line Q = 3.02. Next, lay straight edge from B = 32″ through Q = 3.02. Read intersection on line S_{CR} = 92 lbs. per inch.

With Factor of Safety = 1.80

Allowable Shear = $\frac{92}{1.80}$ = 51 lbs./inch on any edge of the panel.

H. Malcolm Priest January 1938

Fig. 16—Chart for shear buckling

The value of the factor K depends upon the character of the edge supports and the ratio of the width to the length of the panel. For simply-supported edges, $K = 5.35$ for a panel of infinite length i. e., $B/A = 0$, and varies to a value of 9.35 for a square panel. Intermediate values may be approximated from the formula, $K = 5.35 + 4\ (B/A)^2$. For clamped edges, $K = 8.98$ for a panel of infinite length and varies to a value of 15.5 for a square panel. These coefficients are about two-thirds greater than those for simply-supported edges. Investigators have found that the actual coefficients derived from tests are lower than the theoretical values, being nearer 75 per cent of the theoretical value for panels of infinite length. A reserve factor of 1.33 against buckling would take care of this maximum deviation from theory.

A nomographic chart for the ready solution of problems in shear buckling for panels with simply-supported edges is presented in Fig. 16 and is, in effect, a chart linking together the various factors in Formula (55). The example in the lower right-hand corner indicates clearly the manner of using the chart. It may be well to call attention to the fact that in a rectangular panel subjected to shear, the shear per inch is the same on all four sides. In any panel being studied by means of the chart, the shorter side is designated by the letter B, while A represents the longer side.

A practical example will further illustrate the use of the chart and bring out some additional information. Let us examine the panel of a box car side just inside the

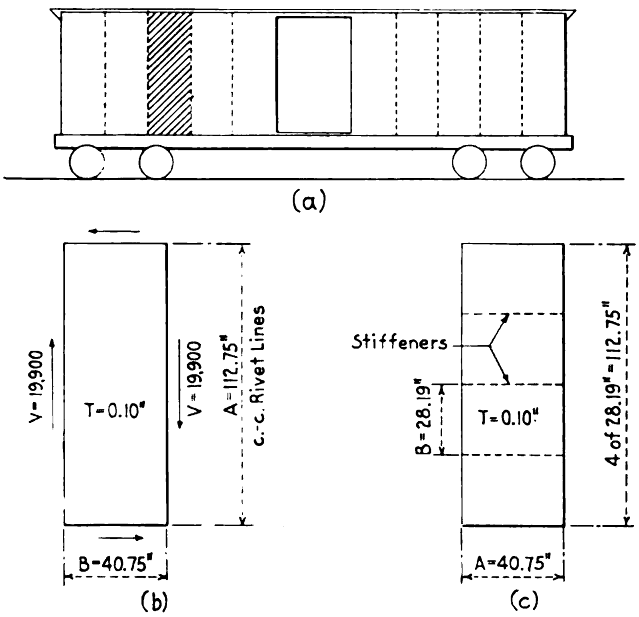


Fig. 17—Shear buckling of box-car side

bolster. Fig. 17 (a) shows the side of the A. A. R. 1937 design of box car. When the car is fully loaded the shear on the edge nearer the bolster is 19,900 lb. and, although the shear diminishes toward the center of the car, let it be assumed that the shear on the inner edge of the panel is also 19,900 lb. The panel to be examined has been cross-hatched and a separate sketch, Fig. 17 (b) shows this panel with the total vertical shear $V = 19{,}900$ lb. The shear per inch $= 19{,}900 \div 112.75 = 176.9$ lb. While it is recognized that the edges of the panel have some indefinite amount of restraint which would increase the value of the critical shearing stress, let it be assumed for this example that the edges are simply supported. In order to use the chart, it is first necessary to compute the value of B/A, which is $40.75 \div 112.75 = .361$. Either by the formula or diagram in the lower left-hand corner of Fig. 16 we obtain the value of $K = 5.87$.

We can now enter the chart to obtain the value of S_{cr}. $Q = 3.50$ on the straight line between $K = 5.87$ and $T = .10$ in. $S_{cr} = 94$ lb. per in. on the straight line from $B = 40.75$ through $Q = 3.50$. Comparing this critical value of 94 lb. per in. with the actual shear per inch of 176.9 lb., it is evident that the side sheet of the ordinary box car is incapable of resisting the full-load shear without buckling. This does not mean any weakness or indicate failure, but simply that the web of the side girder acts as a "tension field" web. Airplane designers deliberately plan for the use of these webs in their structures. It can be shown that in such a web the diagonal tension produces a unit stress equal to twice the unit stress in shear. In the case of this side panel, the tension would equal $176.9 \div .10 \times 2 = 3{,}538$ lb. per sq. in. which is much below the working stress of 16,000 lb. per sq. in. permitted for the grade of steel used. The satisfactory service performance of these steel-sheathed box cars is ample evidence of the adequacy of their design.

Whenever appearance of the finished structure is a controlling factor, as in a passenger car, it may be desirable to prevent the shear buckling. In such cases a large panel may be readily broken up into smaller ones by adding intermediate stiffeners. Using the panel of the box car simply as an illustrative example, let us divide the panel as shown in Fig. 17(c). Using three such stiffeners we have a panel 28.19 in. $\times$ 40.75 in. Following the directions already given for using the shear chart we obtain $B/A = .692$, $K = 7.27$, $Q = 3.70$, and $S_{cr} = 240$ lb. per in. The reserve factor against buckling is $240 \div 176.9 = 1.36$. In view of the fact that buckling due to shear does not mean failure, this factor may be considered ample. This is a matter for the judgment of the designer.

In order that these subdivided panels may resist the shear without buckling, it is essential that the stiffness of the intermediate stiffeners be sufficient to keep them straight and prevent the buckles from passing through them. This subject is treated by Mr. Timoshenko in his book, to which reference has been previously made.

(To be concluded)

Diesel Locomotives in Seaboard Service

(Continued from page 527)

L. Richardson (B. & M.): One thing impressed me very much. That was the 100 per cent performance. The Orange Blossom, when handled with steam, probably had a locomotive of 3,500 hp. Mr. Roy was far-sighted when he stepped the Diesel horsepower up to 6,000, so that the engineman wouldn't have to be working the locomotive near to capacity all the time in handling the train.

It would be interesting to have Mr. Roy tell us about the speeds at which they operate; the speed limit; the average over-all speed and the average power demand made on the Diesel. I imagine that with that horsepower available, there is some leeway in speed to make up for delays in operation.

Mr. Roy: Yes; we get a chance to vary the speed. The average speed at which we operate, if I remember correctly, is from 55 to 57 m. p. h. between Richmond and Miami, although we attain a maximum speed of 80 m. p. h.

(Continued on page 538)

The Causes of

Boiler Explosions*

By J. M. Hall†

The fundamental principles involved — Eight contributing factors are listed

SOME interesting history on the subject of boiler explosions is contained in United States House Documents reporting the committee hearings during the twenty-fifth Congress, third session, 1838-39. At that time there were about 350 locomotives on railroads and the whole number of boilers of steam engines of every kind in the United States was estimated to be 3,010. These documents show that the loss of life from boiler explosions, particularly on steam boats, was appalling, and that the causes were surrounded by much mystery and many fanciful theories were advanced in explanation thereof. We have advanced greatly in knowledge of the causes of boiler explosions since that time and scientific investigators have clearly established the fact that the violence of explosions is governed by well known physical laws.

A vast quantity of energy in the form of heat is stored in the water in a boiler under steam pressure. This is the reason why it is possible to obtain useful work from steam-storage or fireless steam locomotives. The tanks of these locomotives are charged from a stationary steam plant and as the pressure in the tank is reduced, due to the working of the locomotive, the temperature decreases and the heat energy in the water is given up in the form of steam. The drawing off of steam in the working of the locomotive is gradual and the ebullition in the water is moderate. When the throttle is closed, boiling ceases because the water and steam are at a temperature corresponding to the pressure and no more heat is being added. In the case of a fired boiler, the heat from the fire maintains the temperature of the water and also supplies additional heat which converts enough water into steam to replace that drawn off, thereby holding the boiler pressure practically constant so long as a sufficient supply of water and heat from the fuel is present.

It is the former action, water flashing into steam but under uncontrolled conditions, that causes violent boiler explosions. When a rupture occurs in a boiler under steam pressure, or in a steam-storage tank such as previously referred to, the pressure within is suddenly reduced, and the tremendous amount of energy in the form of heat stored in the water converts part of or all of the water, depending upon the existing conditions, into steam which has many times the volume of the water from which it was formed. The capacity of the boiler is then inadequate to hold the increased volume of steam and the rupture will become larger or additional ruptures may occur. The force of explosions often blows boilers high into the air and for hundreds of feet from the points where the explosions occurred.

The effect of a boiler explosion is in proportion to the size and suddenness of the initial rupture and the temperature and volume of the water in the boiler at the time of the rupture. The mechanical energy developed by an exploding boiler is often so great as to lead inexperienced persons to the belief that the accident must have been due to some high explosive. However, steam engineers are familiar with the fact that the tremendous energy released may be readily accounted for. Early investigators, after making all due allowances for various circumstances, established that the destructive energy of one cubic foot of water at a temperature which produces a steam pressure 60 lb. per sq. in. is equal to that of one pound of gunpowder.

The table shows the various classes of locomotive boiler explosions over a series of fiscal years beginning in 1912 and ending in 1938, together with the number of accidents, number of persons killed, and number seriously injured in each of the years given in the table. It will be noted that there has been considerable reduction each year in the number of all classes of boiler explosions from all causes, including miscellaneous firebox failures, and that a low point of five accidents, five killed, and three injured was reached in 1938.

Explosions occur because some part of the boiler is not of sufficient strength to withstand the pressure to which it is subjected. This weakness may be caused by: (1) Excessive steam pressure; (2) weakness in design or construction, including faulty workmanship and material; (3) development of cracks in the plates due to the concentration of stresses from various causes; (4) corrosion or wasting away of material; (5) broken or otherwise defective stays; (6) overheated firebox sheets due to the accumulation of mud or scale or use of unsuitable feed water; (7) overheating of crown sheets due to low water; (8) intercrystalline cracking of boiler plates and rivets often referred to as "embrittlement," or "caustic embrittlement."

Elaboration on the details of the various causes would fill several volumes and will not here be gone into. However, we have investigated accidents causing the loss of life or injury from all of the general causes given except

(*Continued on page 538*)

Various Classes of Locomotive Boiler Explosions

	Boiler Explosions				
	Shell explosions	Crown sheet, low water; no contributory causes found	Crown sheet, low water; contributory causes or defects found	Miscellaneous firebox failures	Total, all explosions and miscellaneous firebox failures
1912:					
Accidents	3	69	23	2	97
Killed	27	35	15	4	81
Injured	41	129	38	1	209
1922:					
Accidents	1	13	14	5	33
Killed	..	15	6	1	22
Injured	1	23	27	5	56
1930:					
Accidents	..	6	5	1	12
Killed	..	7	4	..	11
Injured	..	5	8	1	14
1938:					
Accidents	..	5	..	..	5
Killed	..	5	..	..	5
Injured	..	3	..	..	3

* Abstract of an address before the Engineering Society of Buffalo, N. Y., October 24, 1939.

† Chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission.

Metallurgical Progress in

The Making of Cast Iron*

By R. F. Harrington†

The importance of research, alloys, and modern foundry methods to the production of better cast iron

FUNDAMENTALLY, the great difference that exists between cast iron and steel, so far as their structure and, therefore, their physical properties are concerned, is due to the amount of carbon present, and its manner of occurrence. The definition of cast iron recently submitted to the American Society of Testing Materials for approval is as follows: "Any iron containing so much carbon that 'as cast' it is not usefully malleable at any temperature. (Usually from 1.7 per cent to 4.5 per cent is present, and, in most cases, an important percentage of silicon)." Thus, generally speaking, one can think of cast iron with a carbon content in excess of 1.7 per cent and, with the exception of chilled and white irons, a certain percentage of graphite.

We have, in the case of cast iron, to think of carbon in three forms: (1) Wholly graphitic (rare, except with very high carbon and silicon); (2) wholly combined (as in the case of the chill surface of a car wheel); and (3) partly combined and partly graphitic (most common occurrence).

The factors conspicuous in forming graphite are: Slow rate of cooling and the presence of elements which cause graphitization. The factors tending toward the formation of combined carbon are: (1) Rapid cooling, (2) low total carbon, (3) low silicon and (4) the presence of carbide-forming elements, one of the most potent and important of which is chromium.

A splendid example of these different structures is the chilled car wheel. On the surface of the tread to a depth of approximately 1 in. to 1⅛ in., the carbon is in the combined form due to the use of a chiller which has caused the cooling to be so rapid as to prevent any formation of graphitic carbon. In that portion of the wheel bordering on the chilled part and into the plate we have, both combined and graphitic carbon. Where the combined carbon predominates, this is termed the "mottled structure." Finally, in the balance of the plate and hub, we have a gray or normal structure with a normal amount of graphite present and with good machinability.

Origin of Gun Iron

The Alger Foundry, later the South Boston Iron Works, predecessors of the Hunt-Spiller Manufacturing Corp., specialized in ordnance work. Cyrus Alger, founder of the Alger Foundry in 1810, purified the cast iron by use of an "air furnace." This method consisted primarily of melting the original metal in a long reverberatory furnace fired at one end with highly volatile gas coal, allowing the metal to remain in fusion for an extended period of time, or casting and remelting until such time as the refining action gave the desired physical properties to the metal. These properties were measured to a great extent by the increased density obtained.

This process was used a great deal for gun castings, and hence, the metallurgical term "gun iron" was created.

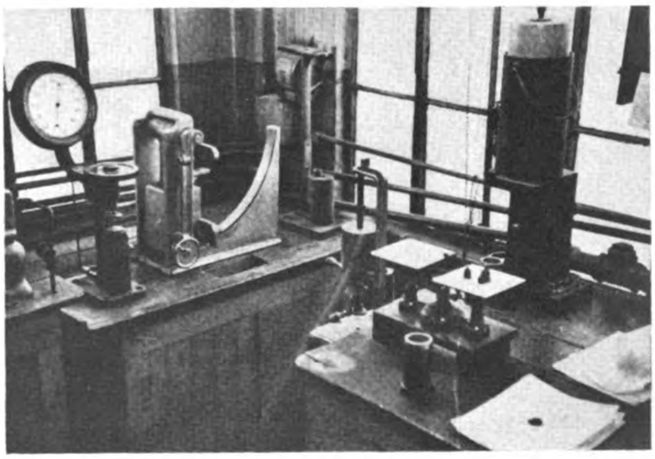
[In the first part of his paper, Mr. Harrington reviewed, in detail, the history of the metallurgical and foundry practice involved in the making of cast iron cannon.—Editor.]

Research Improves Physical Properties

While strength was probably the most important factor in the fabrication of large guns, an important point was the question of wear. These same fundamental characteristics of wear resistance and strength, improved by modern metallurgy, are responsible for the continued use of cast iron in the modern locomotive, in spite of the marked increase in the service demands. This resistance to wear is a property which well-made cast irons exhibit to a marked degree, in contrast to steel, and is associated with particular types of graphite structures, as well as basic or matrix characteristics. It is for this property of resistance to frictional wear that cast iron has best been known, and not until recent years have some of the other excellent properties been given the recognition they deserve. These we shall discuss later in this paper.

Recent years have seen a tremendous amount of research applied to cast iron. This research has been of a very fundamental character, ever seeking to find the true value of cast iron. It has involved an effort to improve the physical properties, through a careful study of the thermal history of many different heats of iron. The microscope has proved a most helpful tool, and much of the advance in the metallurgy of cast iron would have been impossible had it not been for the study of the micro-structures of the iron. Proper structure has been the aim rather than specific chemical analyses.

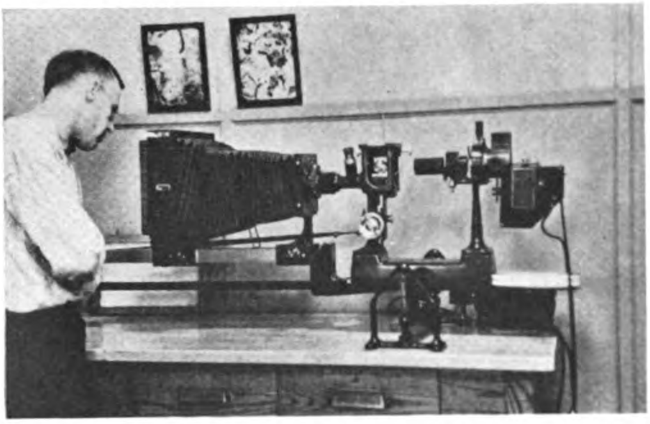
Really remarkable advances have been made in the



Compression and permeability apparatus in Hunt-Spiller sand laboratory

* Abstract of a paper entitled, "From Coast Defense Guns to Modern Locomotives and Industrial Castings," presented at a meeting of the New England Railroad Club, April 11, 1939.

† Foundry superintendent and chief metallurgist, Hunt-Spiller Manufacturing Corp., South Boston, Mass.



Part of Hunt-Spiller metalographic laboratory

improvement of cast iron, as measured by increased physical values. Thus today, we have values for tensile strength of 50,000 to 60,000 lb. per sq. in. or higher. Rightly or wrongly, the improved properties of cast iron have been judged, primarily, by the tensile strength. Unfortunately, some of these irons of extremely high tensile-strength values, lack other properties. For example, it has been found that such irons frequently exhibit less resistance to frictional wear than irons of somewhat lesser strength, but having the right graphite structure.

One might ask as to the means by which irons of such high physical values, especially tensile values, have been obtained. Strictly from the metallurgical standpoint, these results have been obtained by controlling the form and quantity of the graphite flakes. This control originally took the direction of an attempt to lower the total carbon content, thus under the same rate of cooling, reducing the percentage of graphite present. This is most frequently done, especially in cupola practice, through the addition of steel to the charge, which brought about the much-abused term, "semi-steel." Actually, the user obtained irons with steel percentages varying from a few per cent to about 40 per cent or 50 per cent, the actual carbon one finally obtained being quite as much the function of the furnace practice and temperature as the per cent of steel used. Certainly, the use of the term, "semi-steel," should be discouraged because it is unscientific and meaningless.

More recent control of graphite structure has been brought about by so-called, "late addition," of the graphitizing element, either in the furnace just prior to tapping, or in the ladle. Then we have, of course, the part played by alloys to give desired properties to the metal.

These high-strength irons of 50,000 to 60,000 lb. per sq. in., however, are of special interest, from the standpoint of the engineer, in designing structures in the machinery field where advantage may be taken of the high strength values in the reduction of section and weight.

Fundamental Characteristics

Tensile and transverse strength, together with deflection, are considered the most important properties, and are the tests most frequently used. Compressive strength varies from approximately 4.25 times the tensile strength in the lower-strength irons, to approximately 3.4 times the tensile strength for the higher-strength irons. Shear strength will be in the order of 1.0 to 1.6 times the tensile strength, the higher ratio of 1.6 again applying to the lower-strength irons.

Recent work has shown that the endurance limit or fatigue strength apparently varies linearly with tensile strength. The limit varies from about 42 per cent to 57 per cent of the tensile strength. Cast iron is not commonly used to resist impact or shock, yet there are great differences as between one iron and another. Generally speaking, however, impact or shock resistance increases with an increase of tensile and transverse properties. The form and quantity of graphite present is one of the most important factors.

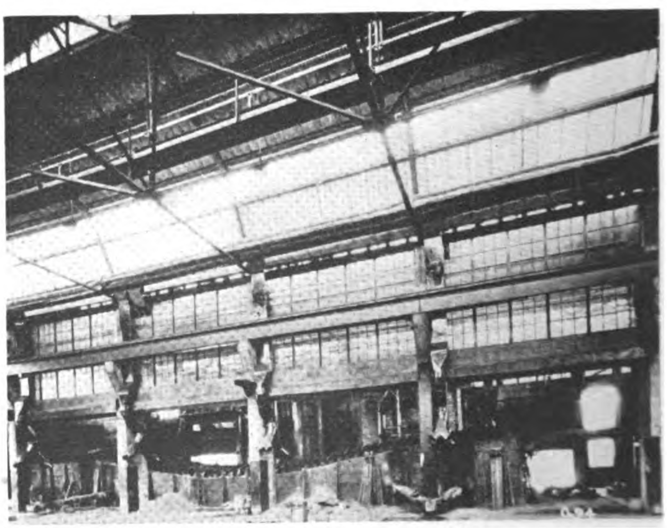
Cast iron has no well-defined elastic limit. Gray irons will sustain static loads up to 80 per cent or more of their tensile strength without failure. The effective modulus of elasticity at 25 per cent of the ultimate strength ranges from 12,000,000 lb. per sq. in. for weak irons to 18,000,000 or 20,000,000 lb. per sq. in. for the stronger irons. In cast iron, the term "modulus of elasticity," generally means the relative stiffness of the iron.

Cast iron has excellent properties in respect to damping characteristics. This property has been most important, in many instances, in helping the metal win back its former place in competition with other materials, particularly the built-up or welded products. Damping capacity is defined as the amount of work dissipated into heat by a unit volume of the material during a completely reversed cycle or unit stress, or in other words, the ability to dampen and absorb vibration. The effective strength of a vibrating member may be much greater if made with a material of high damping capacity and only fair strength than if made of a much stronger material of low damping capacity.

Resistance to notch effect is particularly favorable in the case of cast iron as compared to steel. For example, a test made by Prof. Kommers of the University of Illinois on cast iron with a radial hole showed a reduction of only 13 per cent in endurance limit where, theoretically, the limit should have been reduced 67 per cent. Likewise, cast iron tested with filleted grooves, where it was expected the endurance limit would be reduced 74 per cent, was actually reduced 8 per cent.

Alloy Cast Iron

We have discussed, earlier in this paper, the properties of cast iron applied to frictional or sliding wear. For resistance to abrasive wear in contrast to sliding or frictional wear, irons have been developed ranging in hardness from 300 to 700 Brinell. These irons have been made either through the use of special compositions involving high alloy content or through heat treatment con-



Two 50-ton air furnaces connected with waste-heat boiler

sisting of a quench and draw, similar to that given to steels.

In the so-called gray-iron group of higher alloyed irons, we thus have Brinell hardness values ranging up to 300 without heat treatment, and up to 450 to 500 with heat treatment. These irons have their greatest application in dies for forming sheet metal, and also for certain types of cylinder liners in the automotive industry. Forming dies, it is reported, are yielding production records from 5 to 10 times those of plain iron dies which they have largely replaced. These dies have a hardness of 275 to 300. Composition of the material usually is nickel-chromium iron which, after machining, is subjected to oil quenching and tempering.

In the chilled-iron group, through the use of approximately 4 to 5 per cent nickel and 1 to 2 per cent chromium, irons of 600 to 700 Brinell are obtained without heat treatment. These irons have shown remarkable wear resistance in service. They find their greatest application in grinding burrs, chill rolls, crusher jaws, grinding balls and plates, sand and sludge pump parts, muller tires, chute plates and boxes, and pugmill knives, or generally where abrasive conditions exist.

The resistance of cast iron to heat is well known, especially the tendency to resist warping and twisting as compared to steel. In our early work in the application of Hunt-Spiller gun iron to brake drums, this excellent property was especially noted. It is interesting to point out that at temperatures, for example, of 1,000 deg. F., cast iron loses less of its initial strength than does steel. Likewise, creep of cast iron seems to be less at elevated temperatures than steel.

Where unusual resistance to heat is demanded and where temperatures are in the order of 1,200 to 1,400 deg. F., a superior iron for this service has been developed by certain basic changes in composition where 12 to 15 per cent nickel, together with 5 to 7 per cent copper is employed. Chromium is used in the order of 1.5 to 3 per cent. This iron has proved excellent indeed in the fields where growth and warping, together with permanent distortion, has been an important factor.

This iron has remarkable resistance to corrosion, and many useful electrical and non-magnetic characteristics. Its co-efficient of expansion of .000010 per deg. F. is approximately the same as that of aluminum and, therefore, permits its use in connection with aluminum parts.

In the case of resistance to growth and oxidation, this type of iron may show most unusual results. At temperatures of 1,500 deg. F. and in an oxidizing atmosphere, this iron will show 10 to 12 times more resistance to oxide formation than plain cast iron. Some typical rates or corrosion of this iron compared to plain cast iron are shown in the accompanying table.

This is an iron of modest physical properties, ranging in tensile strength from 20,000 to 40,000 lb. per sq. in., Brinell hardness of 130 to 200, with good machinability, especially in the lower Brinell range.

Heat Treatment

Heat treatment has begun to occupy a more and more important part in the extended use of cast iron. This treatment might be listed as follows:

1—*Normalizing* or stress-relief annealing at temperatures of approximately 1,000 to 1,100 deg. F., for the purpose of removing casting and machining stresses.

2—*Soft annealing* at temperatures of approximately 1,400 to 1,500 deg. F. for very rapid machining where strength factors are not important.

3—*Heat treatment for hardness* where material is heated to 1,550 or 1,600 deg. F., quenched, generally in oil, and then drawn back at a temperature of 600 to 1,000 deg. F., dependent upon the hardness and other physical properties desired. Hardness values up to 475 Brinell are thus obtained where hardness is the principal factor.

4—*Hot quenching*.—A comparatively recent application where the iron is quenched in a heated medium such as a hot salt bath in contrast to a cold quench. This method develops unusual structures which have been found particularly satisfactory for resistance to wear in certain types of cam motion as well as other types of wear. This method has the advantage of a greater freedom from distortion than the other methods.

5—*Nitriding*.—Here an iron is made through the use of alloys, particularly aluminum, and such other elements as molybdenum and chromium, which makes the iron capable of being nitrided in a similar manner to the way in which steels are nitrided. This development, however, is in its early stages, but seems to offer some possibilities.

6—*Flame hardening* is a process whereby an acetylene flame is directed upon the casting in such a manner as to raise the temperature of the surface of the metal above its critical point, following which is a curtain of water which produces upon the surface a condition of hardness similar in character to that type of hardness which is produced when a casting is heated above its critical point and quenched in water. This process is being used in certain applications in the automotive industry as well as in the machine-tool field.

Importance of Proper Design and Scientific Foundry Control

Thus far, we have considered cast iron more from the standpoint of its mechanical properties as measured in the test bar. It is the casting you buy and use, however, not the test bar. Important, indeed, therefore, is the integrity of the casting and its ability to meet present-day demands for a quality product.

A most important factor in the integrity of castings, which should be of interest to every engineer, is the question of design. The Cast Metal Handbook, published in 1935 by the American Foundrymen's Association, gives the following definition in reference to design of castings: "A well-designed gray-iron casting is one that can be made commercially, whose sections are no thicker than is essential to secure the desired strength, and whose members are proportioned evenly to avoid local slow cooling."

Typical Rates of Corrosion of Nickel Resistant Iron Compared to Plain Cast Iron

Corrosion Medium	Comparative rates of corrosion: Ni Resistant	Cast iron
Hydrochloric acid—20 per cent	1	180.3
Nitric acid—20 per cent	1	1.3
Sulphuric acid—1 per cent	1	62.2
Sulphuric acid—20 per cent	1	328.0
Ammonium chloride—5 per cent	1	3.3
Sea water	1	3.7

The greatest co-operation between the designer and the producing foundry is to be urged. Having a proper design then, with a recognition of the many problems involved, the burden of proof must rest upon the foundry to produce the soundest possible castings free from foundry defects and true to pattern.

In our own foundry, this no longer involves hand-fired air furnaces of the old days, but air furnaces, larger and more effectively designed; melting with powdered coal with automatic draft control; electric eye control of the

Reading temperatures with the optical pyrometer on the Hunt-Spiller molding floor

powdered-coal firing; preliminary analysis before tapping, and pyrometer-controlled temperature of the metal at each tap. Each group of castings in respect to design and metal thickness demands irons of the correct temperature for greater solidity, and this in turn involves pyrometer readings of the metal on the foundry floor. This desire for the utmost integrity of the casting demands a mold correct as to method of gating or risering so as to insure maximum soundness; a mold of proper hardness so as to restrain the metal and produce castings as true as possible to pattern; a mold of the right molding-sand characteristics so as to permit free escape of mold gases and of proper strength so as to prevent the cutting of the mold by the incoming metal. To insure ourselves of these conditions, we maintain a sand laboratory devoted solely to the testing of molding sand. Several thousand tests a year are required to assure the necessary control. No longer do we depend upon the feel of a man's fingers to tell the sand's characteristics—all men's fingers are not calibrated the same.

Just as mechanical departments of our railroads have arisen to the occasion, and have met the challenge for locomotives of higher speeds and greater tractive force together with economy, so we in the foundry industry have, through research, with a real heritage to be proud of, endeavored to meet the challenge for irons of better and more uniform quality.

Causes of Boiler Explosions

(Continued from page 534)

the last. The eighth cause is a comparatively recent discovery, and much time, money, and earnest organized effort have been expended to determine definitely the causes and remedies of this form of cracking. Progress has been made, but apparently the final answer has not yet been determined.

The Locomotive Inspection Law and Rules provide remedies, or, at least, alleviations, for the first six causes given. The law and rules provide a factor of safety that thus far has been found sufficient for the types of boilers generally used on locomotives, and require that the working pressure for each boiler shall be fixed by the chief mechanical officer of the railroad involved, or by a competent mechanical engineer under his supervision after full consideration has been given to the design, workmanship, age, and condition of the boiler, and the conclusions of these authorities are checked by our engineering section. It is further provided that the railroads shall make regular inspections, both exterior and interior, and hydrostatic tests, at regular intervals, and furnish sworn reports showing the conditions found and the repairs made. Further, our inspectors are in constant circulation throughout their respective districts seeing that the railroads make the required inspections and repairs and that the boilers, and the entire locomotive, are maintained in such condition that they may be used without unnecessary peril to life or limb.

These remedies have practically eliminated explosions caused by defects in construction, workmanship, and deterioration, but the overheating of crown sheets due to low water continues to give us great concern. In some accidents contributory causes, such as improperly operating feed-water appliances or stopped or partially stopped-up water-gage glasses, were found which may have tended to mislead those responsible for maintaining a safe water level. In other instances there were no discoverable conditions that might have misled or diverted attention. These accidents do occur at times despite the presence on some of the locomotives involved of devices for minimizing the heating of the crown sheet and for giving warning of a rapidly approaching dangerous low-water level, and which seemingly have accomplished their purposes in some instances.

Diesel Locomotives in Seaboard Service

(Continued from page 533)

When we first received these locomotives, I was told by several that the load should be kept as near as possible to 550 lb. per hp. We started out with 13 cars and three Diesel units. (With our steam locomotive, we hauled 12 cars. When we put on the thirteenth car, we lost time, and it was necessary to doublehead.) The next trip, we increased to 14 cars. Now, the reservations are so heavy that we regularly will have to have 16 cars. On several occasions in the past it has been 16 cars.

When we get to a 16-car train, some of our station facilities have to be re-arranged. Otherwise, we would put a passenger off a quarter of a mile from the station, which wouldn't be so good. With these long trains, it has been necessary on several occasions to make two stops to put off passengers. I would illustrate by saying that the Boston car might be up forward when you were stopping at Fort Lauderdale, and perhaps the car with New York passengers would be at the rear of the train, and they would have to get off a quarter of a mile away. Under those conditions, they wouldn't get off.

When we first got the Diesels, they were supposed to be 1,800 hp. Tests indicated that they developed 2,000 hp.

To show the rapidity with which they accelerate with a 12-car train, after starting the train at a station, it was impossible to get on the second car provided a man was standing at the front of that train when it started. With 16 cars, we feel that we have a little reserve.

EDITORIALS

Another Year, Another Index

Send us your name and address if the contents of the editorial pages of the *Railway Mechanical Engineer* for the year 1939 are of permanent reference value to you, and in due course you will receive a copy of the index for the twelve issues of 1939. Subscribers having received the 1938 index are on our permanent mailing list and will receive a copy of the new index without further action on their part.

"Who's Who in Railroading"

Several inquiries have reached us concerning the announcement of a publication entitled, "Who's Who in Transportation and Communication." This is not being published by the Simmons-Boardman Publishing Corporation, publisher of the *Railway Mechanical Engineer*. To avoid any possible misunderstanding, we take this opportunity to announce that "Who's Who in Railroading," one of our publications, will shortly be revised, the latest previous edition—the ninth—having been published in 1930. Plans have been completed for its thorough revision.

Two Schools Of Thought

It is peculiarly an American idea to design passenger-train rolling stock with a view to the behavior of the car structures under destructive forces. Despite our highly developed operating methods and highly disciplined personnel, there is always in the back of the designer's mind the thought that collision or other violent change in the motion of cars are contingencies which he cannot ignore.

In approaching the problems posed by these contingencies there are two opposing viewpoints. There is the belief in rigidity, a rigidity which, to the fullest extent that it can be built into the car, should aim at withstanding flexure and distortion up to the point of ultimate complete failure. There is the belief in the value of flexure and, as the point of failure approaches, of distortion, as cushions to reduce the shock of the ultimate end force and limit the extent of destructive failure.

The cumulative experience of the behavior of passenger cars in wrecks led first to the development of the Railway Mail Service Specifications. With the adoption of materials of greater strength or lighter weight, these specifications have been more closely defined as to certain details and locations. Both represent the views of the "rigidity" school of thought and under them cars are produced which will give a splendid account of themselves up to the point of failure. Within this limit, with favorable circumstances, they may come through the abnormal stress of emergency quite undamaged. On the other hand, the stiffer the structure of the train as a whole, the higher the end force to which its components are subjected and the greater the probability that the most stressed or the weakest point will fail. It has been demonstrated many times that once failure starts in a car structure, it may end in the complete destruction of the car or at least in the destruction of enough of it to snuff out the lives of the occupants. In this type of construction no failure or distortion is to be permitted up to a certain point. Beyond this point there is no control of the kind or amount of destruction which may take place.

The other school of thought is based on the belief in flexure and even of distortion as means of absorbing and dissipating energy and in reducing the magnitude of the end force when rolling stock is subjected to violent shocks. Reducing the magnitude of the end force reduces the probability of a complete and disastrous collapse at some point in the train.

One depends upon the probable complete destruction of one or more cars as a means of saving the rest. The other hopes to prevent complete destruction of any one vehicle, even though there is the probability of some damage to all cars in the train.

Carried to its logical conclusion, the latter viewpoint calls for the construction of definite weak points in the car structure so that failure of the structure may be as much under control as is the resistance to failure and distortion of the more rigid structure.

This is by no means a new idea. Many years ago the incorporation of wire rope in the end structure of passenger cars was proposed as a means of utilizing the cushioning effect of the destruction of a part of the car superstructure near the ends and at the same time reducing the probability of complete telescoping of the car. A more practicable approach to the same objective has been incorporated in an articulated car of aluminum alloy construction now in operation on the Brooklyn-Manhattan Transit Line in New York City.

Aluminum cylinders on the end sills crush longitudinally under a high force in case of collision shocks. This force acts through a distance great enough to dissipate a definite and substantial amount of energy and to effectively reduce end forces at the time of ultimate contact with the car body, which otherwise might have

damaged or destroyed it. Thus, the car structure, as well as the passengers, are protected by a controlled failure when dangerous forces are encountered.

Does not the more practical approach to the problem of energy dissipation under collision shocks lie in a structure with strength controlled to permit progressive failure by crushing of some part of the structure before the maximum resistance to failure is developed? Cars of such design, made up in a train would probably all, or nearly all, be damaged under severe collision shocks. The distance through which the cushioning resistance of controlled failure would act, could be great enough, however, to keep the end force down to a point at which no car need fail completely. Even though the total damage to equipment might be greater than in the case of cushioning the shock by the complete destruction of a single car, the hazard to passengers would be reduced by a the absence of complete destruction of any car.

If protection of passengers in case of collision shocks is a primary consideration in passenger-car design, then the control of the ultimate failure of the car structure should certainly be as valid an objective of the designer as the control of the rigidity of the structure up to the point of failure.

Lightweight Passenger Cars In Great Britain

While passenger train cars in Great Britain have always been relatively smaller and hence lighter than those common in American practice, British railway officers have not been slow to recognize the advantages in additional weight reductions which can be secured without sacrifice of strength. According to William A. Stanier, chief mechanical and electrical engineer, London, Midland & Scottish, in his paper written for the cancelled British-American Congress which was scheduled to take place at New York Sept. 4-8, 1939, an abstract of which is published in the December Mechanical Engineering, the restricted clearance limits in the British Isles of about 9 ft. between the high station platforms and 13 ft. 1 in. allowable height above rails, place a definite limit on locomotive size and restricts the maximum train weight to 660 tons, the coaches being generally 60 ft. long and weighing 33 tons. Previous British practice has been to provide a heavy steel underframe on which is mounted a wooden frame coach body sheathed in steel and having a steel roof. In the last few years, however, important departures from the traditional British standard form of construction have been made, utilizing high-tensile steels and electric arc- and spot-welding in an effort to effect substantial weight reductions.

In the new designs of British passenger cars the separate identity of the body as distinct from the underframe has been largely abandoned, the underframe and body being based on the Vierendeel truss which consists, according to Mr. Stanier, of a simple but rigid frame incorporating parallel top and bottom chords, with equal sections and a number of vertical columns which are rigidly connected to the chords to transmit bending movements as well as tension, compression and shear. The working out of this form of truss and its application to rolling stock is credited to the design office of the London, Midland & Scottish.

In this method of car-body design, the main underframe members form the bottom chord of the truss, the roof structure forming the top chord and the body side pillars, or posts, performing the functions of the columns. The panels are 1/16 in. thick and where unsupported over a considerable area, it is assumed that their resistance to buckling will not be great enough to justify taking them into account. Their use, however, is said to add to the factor of safety of the whole structure.

In the fabrication of the car trucks by welding, special attention has been given to the junctions between the side frames or sills and cross members. The gussets are designed to reduce stress concentrations at the corners and at the same time leave the joints as strong and flexible as possible. Gussets are not butt welded to the members but overlap them, thus tending to produce a more reliable joint. Free edges are curved to reduce rigidity and a further saving in weight is affected by the use of smaller wheels, namely, 3 ft. in diameter as compared with 3 ft. 7½ in. in former types.

In the construction of these cars at the railroad company shops, it is interesting to note that, in spite of a production limited at times to three cars a week, the same progressive unit-assembly method is used which has, generally speaking, given such satisfactory results in American practice.

Internal Streamlining

In his papers before the Railway Fuel and Traveling Engineers' Association at the 1938 and 1939 conventions, F. P. Roesch, vice president of the Standard Stoker Company raised some very pertinent questions concerning a number of details of locomotive design, most of them having to do with drafting and combustion. Some of these were at one time more or less necessary compromises which have survived the conditions which justified them. Some of them are obsolete or at least lacking in justification in the light of present day knowledge. Such a one is the cluttering of smoke boxes with obstructions to the flow of gases from the tube sheet to the stack, which called forth Mr. Roesch's comment that a job of internal streamlining is needed in the front end.

At the outset of its adaptation to railway rolling stock streamlining was thought to be justified by its effect in reducing wind resistance at the higher ranges of passenger-train operating speeds. Such benefits were

generally considered to begin at speeds of about 50 or 60 miles an hour and, there is no doubt but that they are appreciable at the new cruising speeds of 90 to 100 miles an hour. Comparing these velocities of air flow with the velocities of steam flow from the boiler to the cylinders, and the velocity of gas flow through the tubes and front end, it would seem that there is at least as much to be gained from a job of internal streamlining as from a job of external streamlining. Indeed one of the factors which contributed to the great increase in capacity and efficiency of the Paris-Orleans locomotives rebuilt under the direction of André Chapelon was the careful redesign of steam passages to eliminate to the fullest extent possible all obstructions to the free flow of the steam to the cylinders.

The possibilities of improvement in the performance of the locomotive by a job of internal streamlining in the smoke box are probably not as great as in the case of the steam flow. On many existing locomotives the need is appreciable, none the less. Turbulence in their movement through the front end requires increased cylinder back pressure to produce the draft required in the firebox.

The Answers Are Coming to Light

In the 15 years that the Diesel-electric locomotive has been in the service of American railroads there have always been certain questions the answers to which were dependent upon future experience. Today there are over 600 units of this type of motive power in operation and while the records are far from complete the experience of the roads operating these locomotives is bringing out the facts that enable us to remove the uncertainties one by one. The paper read recently by E. H. Roy, general superintendent of motive power of the Seaboard Air Line, before the New England Railroad Club, which appears elsewhere in this issue contains a number of the answers.

Analyses of the relative costs of the items of operation have conceded, for practical purposes, an equality in the matter of wages, supplies and enginehouse expense between Diesel and steam, with fuel costs favorable to the Diesel and lubrication and fixed charges favorable to the steam locomotives. One of the big question marks so far has been the cost of maintenance. Certain information is now being brought to light concerning maintenance cost that looks as though Diesel repair costs are not going to run as high as many people thought they might. The figure of 6.0 cents per mile which Mr. Roy gave as the Seaboard's cost for two million miles of running and the 9.5 to 12.7 cents for the New Haven's Comet are not excessive costs compared to steam.

All through the paper and the subsequent discussion run two significant thoughts—the Diesel-electric is established as a part of American railroading because it has shown its ability to attract revenue in passenger service and save money in switching service and, like all other transportation facilities, its future, now that the fanfare of its initiation is over, depends entirely on economic justification. American railroads are fortunate that they have such highly developed transport tools to choose from. Let us hope that the next 10 years will see such spirited competition between steam and the Diesel that their development will result in a reduction of operating costs far below present levels.

New Books

A HISTORY OF THE GROWTH OF THE STEAM ENGINE. *Centennial edition. By Robert H. Thurston. Cornell University Press, Ithaca, N. Y. Price, $3.*

Among the many Thurston publications exhibited at Cornell University on October 25 in celebration of the one hundredth anniversary of the author's birth was the centennial edition of "A History of the Growth of the Steam Engine" published especially for the occasion by the Cornell University Press. The appearance of this book in 1878 met the need for such a work in so satisfactory a manner that the book passed through six editions, an additional chapter being added to the last published in 1907. The supplementary chapter added to the centennial edition traces some of the more important developments in steam power engineering since the close of the nineteenth century. It was prepared by William N. Barnard, M.E., director of the Sibley School of Mechanical Engineering, Cornell University.

MANUAL ON CUTTING OF METALS. *Published by the American Society of Mechanical Engineers, 29 West Thirty-Ninth street, New York. 320 pages, 5½ in. by 8½ in. Price, $5.*

The Committee on Metal, appointed in August, 1932, by the A. S. M. E. Special Research Committee on Cutting Metals in an attempt to correlate the work done by many investigators since the presidential address of Frederick W. Taylor "On the Art of Cutting Metals" in 1906, has limited its present effort to a study of single-point cutting tools as used in turning in the lathe or similar machines. The manual, written to meet the requirements of the shop, is in a form that can be used directly by the mechanical engineer, production executive, machine designer, or shop mechanic. It comprises: Part I—Factors influencing the cutting of metals; Part II—A series of tables of cutting speeds and horsepower for various cuts on different ferrous materials, and Part III—The equations and constants required for calculating cutting speed, economic tool life, chip pressure, and horsepower, with instructions as to their use. Data on the use of tool shapes, depths of cut, feeds, etc., while not presented in the tables, can be calculated from the information given as to general relations.

Master Boiler Makers' Report on

The Renewal of Fireboxes*

Committee report describes in detail the various methods used in the laying out, fabrication, and application of locomotive fireboxes

Report by R. W. Barrett

General Boiler Foreman, Canadian National

With the application of all-welded fireboxes, it is no longer necessary nor economical to remove the boilers from the frames. New firebox repairs are handled the same as any other class repairs and foundation rings are not disturbed. The following procedure for removing old fireboxes is based upon the fact that the old sheets are used as templates for marking off the new sheets, due not only to the various classes of locomotive boilers, but also to boilers of the same class being built by different builders and varying in their staybolt layout.

Outlining Sheet—Line up all sheets for cutting. If the wrapper sheet is to be applied in three pieces, make the joints of the side sheets and crown sheet not less than 15 in. below the highest point of the crown sheet as shown in Fig. 1. Line up the side sheet at the tube and door ends, leaving 3 in. of flange on each sheet and the crown sheet can be split through the center longitudinally for convenience of removal.

Burning Out Sheets—Cut off all inside foundation rivet heads with an oxy-acetylene torch and burn in rivets, the thickness of the firebox sheet. All staybolts are then cut as shown in Fig. 1. All sheets are now cut through where lined up and removed in the following order: Side sheets, tube sheet, door sheet and crown sheet.

Removing Staybolts From Outside Firebox Casing—As shown in Fig. 1 the butt of the staybolt is burnt off at the outside of the sheet, then play the torch at the telltale hold of the staybolt, meanwhile the helper applies a length of pipe on the protruding end of the staybolt. As the telltale hole cavity is enlarged, the helper will rotate the pipe in a circular motion, thus reducing the heated staybolt in diameter, which is now easily removed from the hole.

Repairing Foundation Rings—Worn and corroded areas at the bottom and caulking edges are built up with electric-arc welding and chipped smooth where necessary. Where there is excessive corrosion and holes are large, new side sections are welded in.

Laying Out and Fabrication

Side and Crown Sheets—Using the old sheets as templates simplifies the job of laying out. These sheets are rolled flat and if a one-piece wrapper is to be applied, the old sheets are laid together on the new sheet. All staybolt and rivet holes and edges to be cut are lightly center punched.

Firebox Tube Sheets—The old tube sheet is elevated on pedestals on top of the surface block and the outline of the sheet is transferred to the block. Center lines and the location of foundation-ring rivets are located on the surface block and the old sheet is then removed and the new sheet set up on the block and squared up with the outline of the old sheet. Center lines, etc., are transferred to the new sheet and flange-cutting line marked with a surface gauge. Tube holes are marked off from the template and staybolt and ring rivet holes are marked off from the old sheet.

Door Sheets—Door sheets are also marked off from the old sheets. The firehole section is burned out which permits the door sheet to lie flat on the plate with the flange up. All holes are then center punched and the outline of the sheet is marked on the plates.

Application to Boiler

Assembling—Sheets are applied to the boiler in the following order: Side, crown, tube and door sheets. The

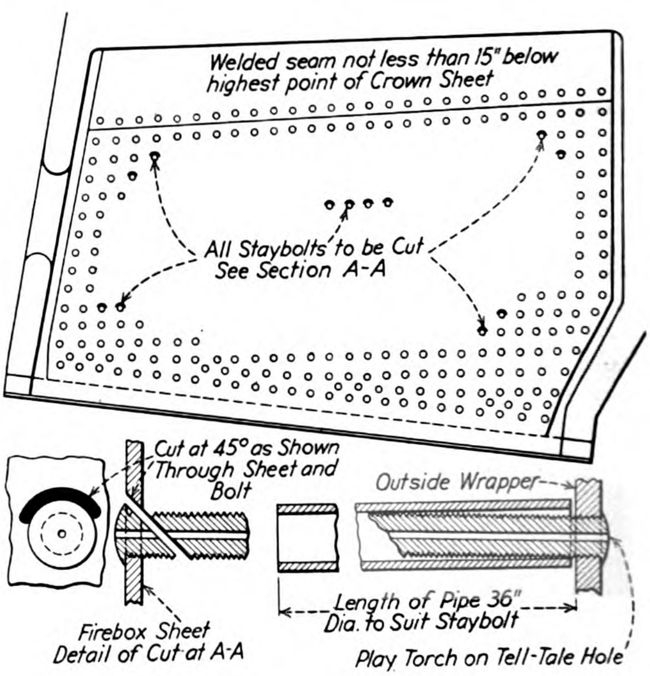


Fig. 1—Details of cutting sheets for removal of firebox

* This report was one of the eight technical reports presented at the annual meeting of the Master Boiler Makers' Association on October 17, 18, and 19 at Chicago.

junction of the crown sheet and the side sheets is lined up and clamped for welding as shown at A, Fig. 3. Staybolts are run in from the outside about every fifth hole up against the inside sheet at the required water-space distance, then through the middle hole 7/8-in. service bolts are applied. This method securely holds the plates in position while being welded. The flanges of the tube sheets are trued up and securely held by the use of clamps, as shown at B, Fig. 2. These clamps are applied either inside or outside as may be necessary.

Welding—The firebox is now ready for welding which is done by the electric-arc method. First, the fire sheets are tack welded at various intervals, then the entire box is welded in the following order: Side sheets to crown (if applied in three pieces), the legs of both the tube and door sheets, crown sheet at the door and

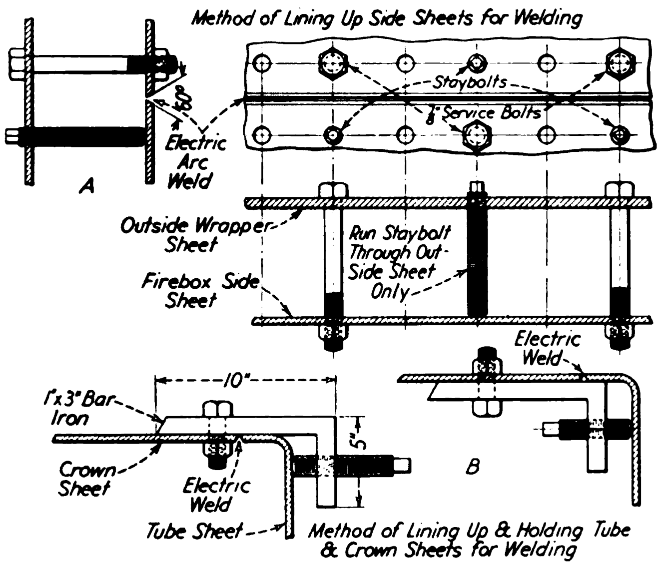


Fig. 2—Jigs for lining up the sheets

tube ends, the firehole. After completion of the welding inside of the firebox, the top of the tube sheet on the water-space side has a light reinforcing weld applied as far down the side as possible.

Riveting Foundation Ring—While the firebox is being welded, all foundation ring holes are reamed from the outside, after which the ring rivets are applied by the double-gun method, the rivet being applied from outside the firebox.

Staybolting—The application of staybolts and crown-bolts is one which demands our best consideration if we are to avoid leaky staybolts. All bolts are set to a

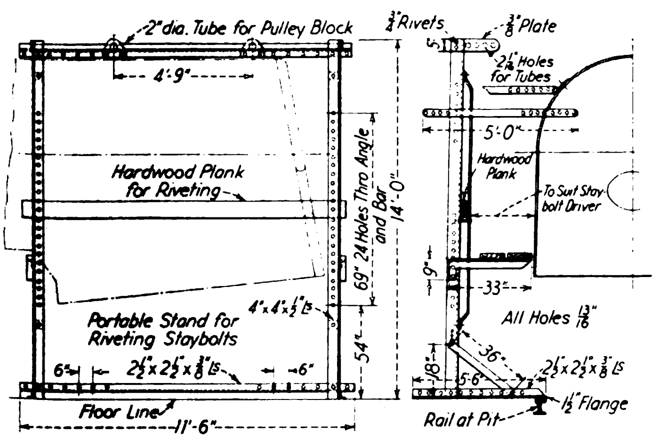


Fig. 3—Portable stand for the double driving of staybolts

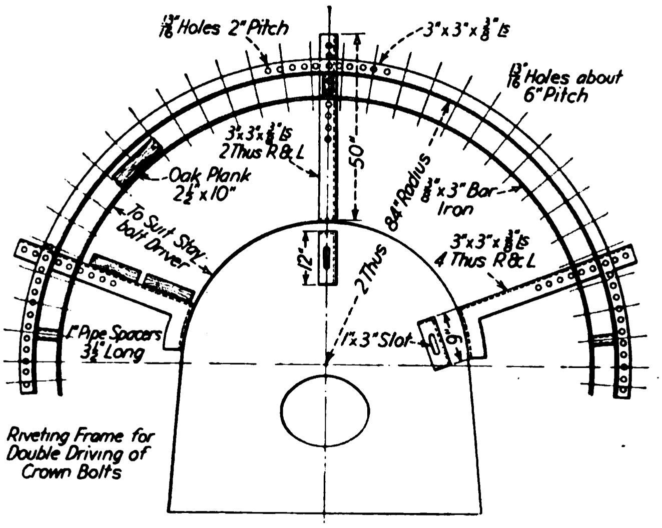


Fig. 4—Frame for riveting crown bolts

gage to protrude through the sheet 1/4 in. All staybolts are riveted with a combination holder-on and driver. The inside and outside ends are riveted simultaneously, the outside hammer being supported by an angle-iron frame scaffold, as shown in Fig. 3. The top of the frame is held by stays located on any convenient stud.

All crown bolts are also riveted by the double-gun method. For supporting the hammer outside, a frame, shown in Fig. 4 is erected. This frame is erected before the crownbolts are applied, as it provides a safe platform and support for the air motor when tapping holes from the outside at the crown. The bottom knee angles are fastened by a bolt through a staybolt hole, and the top supporting angle is located on a convenient stud.

Report by W. L. Kleninger

General Boiler Foreman, Atchison, Topeka, and Santa Fe

The flues are removed from the old firebox. The firebox wrapper sheet is cut with an oxy-acetylene blowpipe into about 10 sections and the mud-ring rivets are removed from the firebox sheets. The flue area of the back flue sheet is removed by the use of the cutting blowpipe. The staybolts are then cut from the outside wrapper plate, first removing those in the lower sections to permit the side sections to be removed, then removing the crown-sheet sections and permitting them to fall to the floor. The door sheet is likewise removed in similar sections. These sections are usually four to five staybolt spaces wide and about 12 to 16 staybolt spaces in length. These sizes are found to be the most convenient for handling.

The removal of mud-ring rivets and corner plugs from the outside wrapper sheet is made so as to remove the mud ring, after which the boiler is given an internal inspection. If it is found that the staybolt holes are to exceed 1 1/8-in. diameter, consideration is given to the application of bushings or new outside casing sides, based on the number of staybolt holes to be bushed.

Since the new firebox plates have all been laid out, they are moved to the shears for shaping and then to the punch and the drill, respectively. All holes in the wrapper sheet for the stayolts are punched 13/16 in. in diameter except those within the location of the short radius of each side of the crown sheet. These are drilled after the plate has been rolled to the proper shape. The door and flue sheets are sheared and made ready to

punch. All staybolt holes are punched $1\frac{3}{16}$ in. in diameter and flue holes are punched $1\frac{5}{16}$ in. except the outside holes adjacent to the flange. The door and back flue sheets are then placed in the annealing furnace and the flanges are squared and the sheets are straightened or properly shaped during the same heat. The flue- and door-sheet flanges are laid out for rivet holes and these are punched at the flange punch, except for the lower 12 holes on each flange and the outer rows of staybolt and flue holes which are drilled. The rivet holes in the flanges are countersunk and the flanges are chipped to the standard taper for fireboxes or from the thickness of the plate to $\frac{1}{4}$ in. at the caulking edge.

The wrapper, door, and flue sheets are then fitted into the mud ring and all flanges are laid up. Riveting is started at the top center of the crown sheet working down one side at a time using a No. 90 pneumatic hammer and all rivets are double gunned. After the firebox is in place, it is squared up with the outer casing sheets and held in place with strong backs that also hold the plates in line and the fire door is then laid up to the hole in the back head, prepared, and electric welded.

All staybolts and radials are cut off to length by the oxy-acetylene cutting blowpipe, leaving from three to four threads for heading of bolts. All flexible staybolt holes are threaded and the flexible stays are applied after the rigid staybolts. The flue holes in both the front and the back flue sheets are examined for roughness and filed before copper ferrules are applied to the back flue sheet only and made ready for the flues by rolling into place, being sure not to permit the coppers to project on the fire side of the sheet.

Report by E. H. Heidel

General Boiler Foreman, Chicago, Milwaukee, and St. Paul

With the universal use of welded seams in the firebox, the renewal of firebox sheets can be accomplished more economically by applying the sheets while the boiler is on the frame. When removing the old firebox, the rivet heads should be cut off with a torch or rivet buster, depending on the heads of the rivets. Staybolts and radials should be cut off, after which the sheets in the firebox are cut into sections about 24 in. by 36 in., which are convenient for handling. Lower sections are removed first.

When replacing the firebox sheets, the new sheets are laid out from the latest blueprints. Patterns for crown sheets, side sheets, door sheets, flue sheets, etc., should be used for interchangeability and, if not available, the sheets should be developed and patterns made. After being laid out, the sheets are sheared and staybolt holes drilled $\frac{3}{16}$ in. smaller than the threaded size. Pilot holes for the flue hole cutter are punched in the flue sheets, except possibly for the flues adjacent to the flange.

In applying the new sheets, the crown sheet, door sheet and flue sheet should be placed in the back end, after which the side sheets are applied. All seams should be prepared for butt welds, preferably with a row of staybolts on each side of the weld. Welding should be done from both the fire side and the water side of the sheet wherever possible, and in locations where it is not practical to weld from the water side, penetration of the weld should be checked by means of a small light on a gooseneck extension which can be inserted through the adjacent staybolt holes.

After the sheets are applied, a few bolts are put in through the sheet to stay it. Bolts must be applied with a snug fit. Bolts too tight in the sheet are just as bad as bolts too loose, and a bolt which can be readily handled with a 16-in. wrench will give the best results. Staybolt holes should be tapped from the outside. Bolts should be cut off with three threads outside the sheet, and square with the sheet to secure a good uniform job.

Taper crown bolts, applied from the inside, should be used in the center rows of the crown sheet and back of the first five or six rows of expansion bolts. Flexible bolts should be applied in the breaking zones, and welded sleeves should be used exclusively.

Report by L. J. Murray

General Boiler Foreman, Western Maryland

The Western Maryland varies from the assembly of the plain firebox by the introduction of Nicholson thermic syphons. We require syphons to be furnished with flanges of sufficient width and length to form the entire crown sheet as shown in Fig. 5. This method reduces the amount of welding required for an installation and as the crown stay holes are drilled in the flanges, the crown sheet is actually in place when the syphons are installed.

After the syphons are set in place, being sure they are set at the proper transverse spacing for application of a brich arch, they should be welded at the crown. While this is being done, the syphon necks should be free to move about in the diaphragms and this requires that the diaphragm holes should have sufficient clearance for considerable movement. With welding completed, the holes for the crown bolts are tapped, bolts applied and driven with the syphon necks still free to move as it has been proved that driving crown bolts raises the sheet and the syphons. Allowing the necks to move avoids locking up initial strains in the necks. The final operation of the entire installation is closing the diaphragm flanges about the necks and welding in place.

There are times when the back trailer frames are removed to apply the firebox without removing the boiler from the frames. This is based on the condition of the smoke box and waist sheet bolts. When the trailer frames are not removed and the boiler remains on the frames, the back end is removed from the boiler at the connection seam.

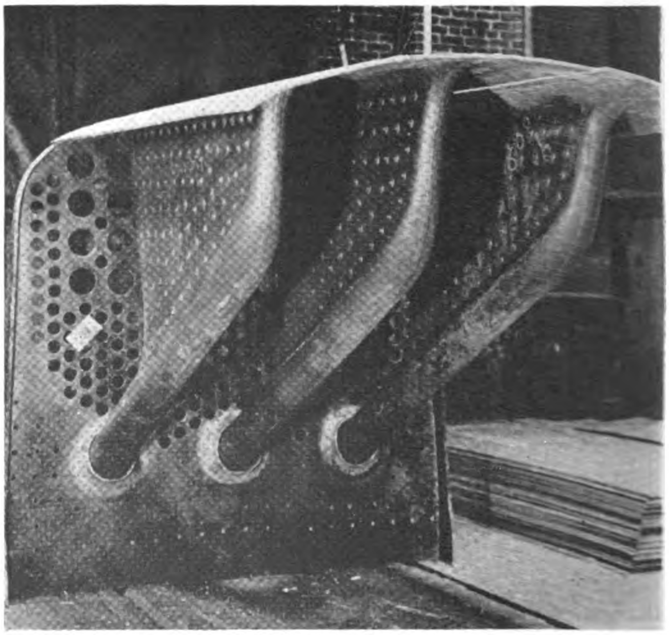


Fig. 5—The large syphon flanges form the crown sheet

Report by F. A. Longo

Welding and Boiler Supervisor, Southern Pacific

The more economical and safer method of renewing fireboxes in locomotive boilers is to remove the boiler from the frame. The new firebox can be assembled and fitted together better on the floor than it can be assembled in the boiler.

The removal of staybolts from the boiler may be done according to the procedure indicated in Fig. 6. The flame of the cutting torch should be directed against the edge of the telltale hole until the metal is heated. The cutting jet of the oxygen is then gradually applied, while at the same time the cutting torch is moved back and rotated so that at a distance of 1¼ in., the full pressure of the cutting jet is being used. After a depth of approximately ½ in. is reached, the flame should be directed at a 45-deg. angle to the bolt until the flame pierces the bolt, thus completing the operation.

The type of weld used in the new fireboxes is the single, V-weld and, as the welders have access to both sides of the sheet, the seams must be welded from both sides. The success of a welding job depends a great deal on how it is prepared and, for this reason, the welder should see that the work to be done is properly

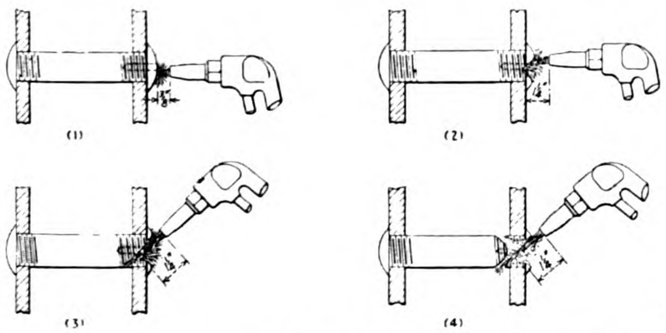


Fig. 6—Procedure for removing staybolts by use of the cutting torch

bevelled and the edges thoroughly cleaned from dirt, scale and grease.

When applying staybolts to the side sheets, a few scattered holes should be tapped and staybolts applied so there will be no possibility of the sheets getting out of alignment while being tapped. Where staybolts are being applied at the same place where threaded, it is better to fit the staybolts to the sheet, rather than to a gauge. This will eliminate the possibility of the staybolts becoming too tight, due to tap wear.

Staybolt application should start at the foundation ring and work up. This will insure the long bolts being used where they belong. All rigid staybolts in close proximity to flexible bolts should be in place before the application of flexible bolts. The fit in the sheet must be such that the ordinary strength of one hand on a 12 in. wrench is just sufficient to turn the bolt in the sheet.

In tapping holes for flexible bolts, it is important to screw a cap or plug in the outside sleeves and in cases where no sleeves are used, a bushing should be applied in the holes in the outside sheet, which permit the extension on the tap to serve as a guide in tapping out the hole in the inside sheet, thereby giving assurance of a perfect alignment of the hole with the sleeves on the outside sheet. When cutting the threads on the bolt-threading machine, the top end of the taper radial in the outside wrapper sheet should be a trifle loose and the bottom end should fit snug.

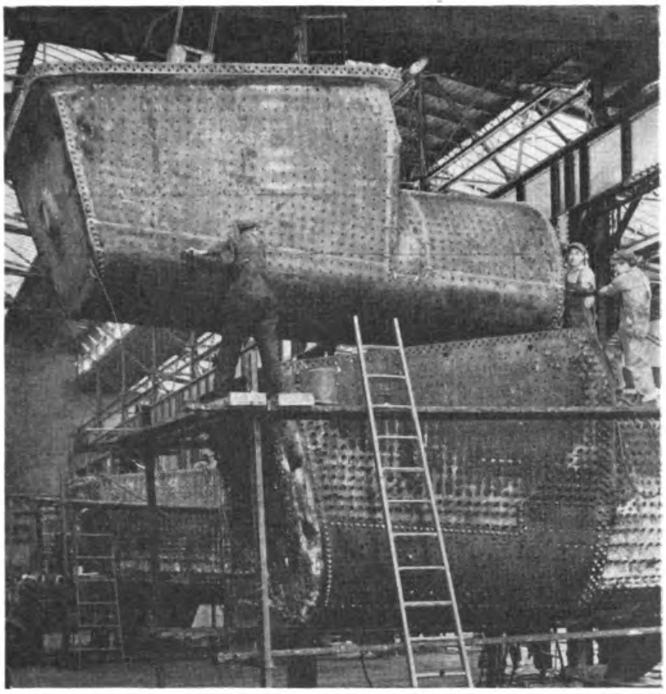


Fig. 7—First operation in assembly of new firebox with boiler

Report by E. J. Brennan

General Boiler Foreman, Boston and Maine

Where shops are equipped with overhead cranes or other facilities to properly handle boilers off and on the frames, it is far more economical and efficient to apply fireboxes with the boiler removed from the frame. When boilers are removed from their frames and placed on rollers, they can be turned into whatever position is desired to perform the different operations.

The firebox is assembled on the floor. Sheets are placed in the mud ring, lined up, chipped, and fitted for welding. Sheets are beveled and welded from the fire-side and reinforced or back-welded on the water side.

(Continued on page 549)

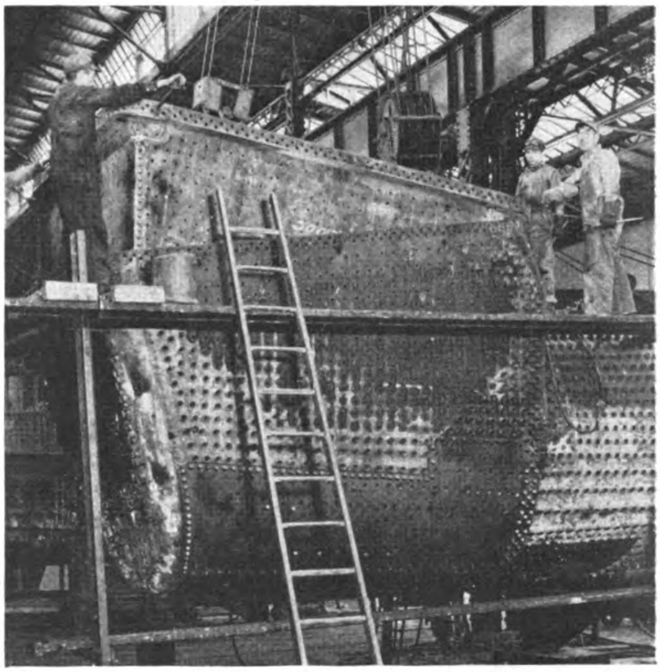
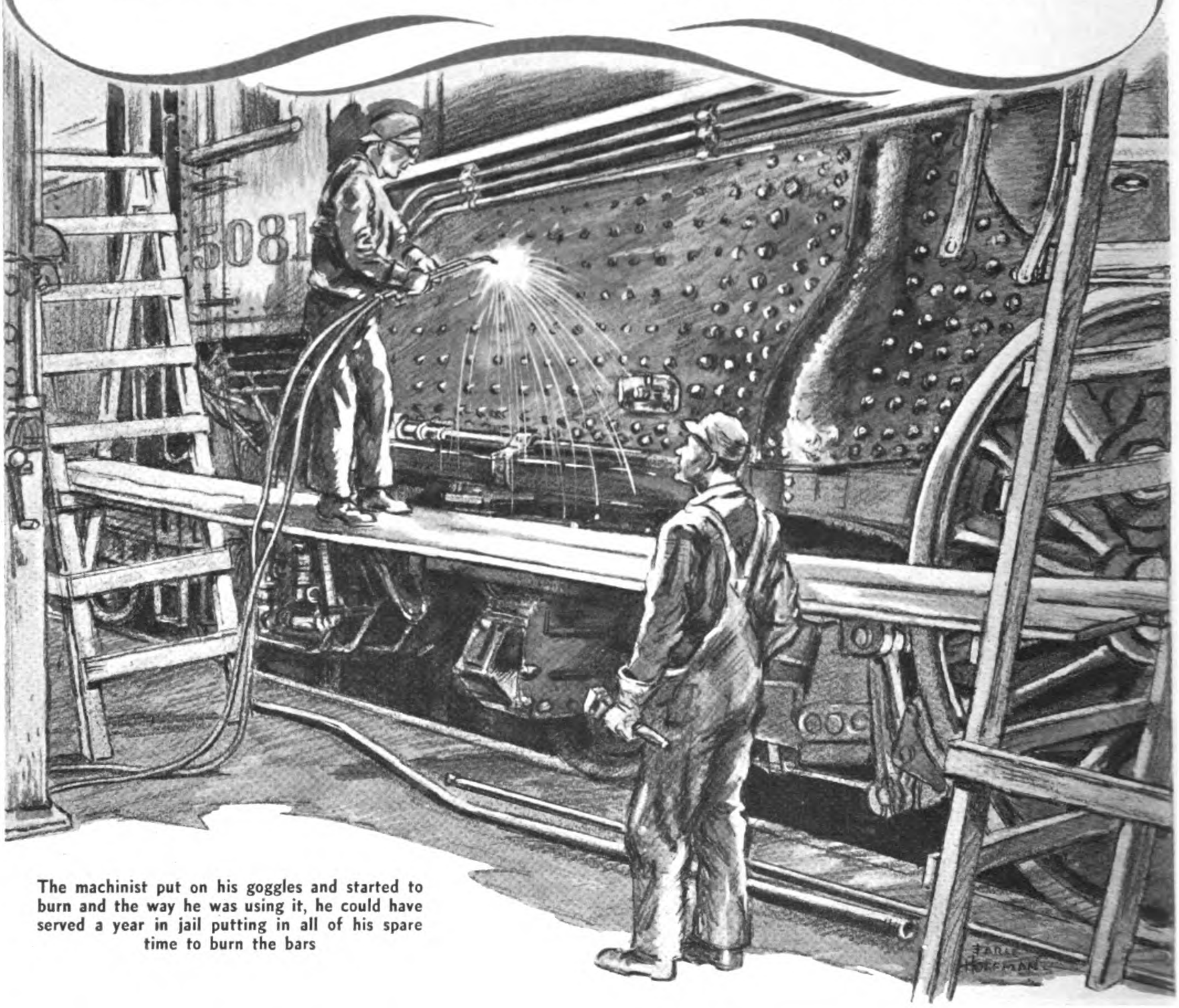


Fig. 8—Second operation in assembly of new firebox with boiler

GOOD MEN ARE HARD TO FIND



The machinist put on his goggles and started to burn and the way he was using it, he could have served a year in jail putting in all of his spare time to burn the bars

by **Walt Wyre**

LAST summer when business on the Plains Division of the S. P. & W. was poor and forces reduced in proportion, washroom rumor predicted that the roundhouse at Plainville would be abolished and the equipment moved away. Now that business has picked up and four new stalls being added, washroom gossip has planned complete rebuilding and extending of the roundhouse, new and larger machine shop equipped with new machines and other facilities to match.

Chances are that the present rumor has no more truth in it than the previous one, but that is not what is worrying Jim Evans, the roundhouse foreman.

When business started falling off, appropriations for maintenance of equipment were reduced. That meant laying off men. Locomotives were laid off, too, taken out of service and stored on the "dead" track. Some of the locomotives stored were in fair condition for service.

Then the force was reduced to a point sufficient to

handle only running repairs. Locomotives that were long overdue for classified repairs continued to run until they became standing invitations for Forms 5. In desperation Evans took serviceable engines out of storage and replaced them with ones that weren't until some would-be wit dubbed the dead storage track "the five-year test track."

The European war revived railroad business like a dash of ice water in the face of a person asleep. Before anyone was well aware of the fact, the business was there and no power to move it.

Every furloughed mechanic was called back. Some of them came, others had found jobs and accumulated seniority at other points. A call was sent out over the S. P. & W. system for mechanics and plenty of them answered the call.

Most of the men reporting for service were from backshops with little, if any, roundhouse experience.

EVANS was two engines short and four hours behind when Dudley Davis and Ray Harper, both machinists, reported for duty one morning about nine-thirty. The foreman was out at the dead engine track trying to figure which one of the 5000's had enough serviceable parts to build an engine from and wasn't due a five-year test.

"Are you the roundhouse foreman?" Davis asked Evans.

"Yes," Evans admitted, "and I won't have time to talk to you until sometime this afternoon; maybe not then."

"We were told to report to you to go to work. We are machinists," Harper said.

"Why didn't you say so? How soon can you start?"

"We weren't figuring on going to work until in the morning," Harper replied, "but guess we could start at noon today."

Evans was walking around the 5081 while the conversation was going on, the two nut-splitters following. "Had any running repair experience?" Evans asked, at the same time looking the locomotive's valve motion over.

Both men had done some running repair work, but not in many years. Davis had been in the erecting shop the past twelve years, while Harper had been running a small turret lathe.

"Well," Evans stopped long enough to bite off a chew of horseshoe, "I'll have this engine in the roundhouse by one o'clock. Look it over, Davis, and do whatever is necessary to make it fit to run. Some of the rod bushings will have to be renewed. I think I can use you in the machine shop," he said to Harper.

Davis was fitted up with a tool box, assigned a helper, and told to start in on the 5081. He went to work with a will taking off rods as though he were on piece work at so much each for rods removed.

He dropped all the rods on the right side, then did the same on the left. That finished, he looked over the valve gear, decided it needed new bushings throughout and started taking the valve gear down.

About that time Evans came by to see how the new machinist was getting along. The foreman looked at the rods on the floor beside the engine and blinked his eyes like a toad in a hailstorm.

"Did all of the rods have to come down?" Evans asked.

"Yeah," Davis knocked a pin out of the valve gear, "all of the bushings are pretty badly worn. I think both main pins need grinding——"

"You mean you are figuring on renewing all the rod bushings on both sides and truing up the main pins?"

"——and new bushings in the valve gear," Davis added. "That's all I've looked at so far."

"Jumping hot boxes!" Evans exploded. "I didn't mean do everything the engine needed! I meant do just what is absolutely necessary to make a trip. If bushings are not worn right up to the limit, let them go! Have you got a machine man started making the bushings yet?"

"No, I thought I'd get it all torn down, then get a lathe man started on the machine work," Davis said.

"Well, put the rods back up and just renew the worst bushings." Evans turned and walked to the board, talking to himself.

He had planned to run the 5081 on an extra west at 6:45, but chances were beginning to look slim.

Davis put the rods back up on the left side, then did the same on the right. Evans, busy with a hundred and one odd jobs and in between trying to stall off the dispatcher who was asking for engines, didn't get back to the 5081 until nearly four o'clock.

"How are you coming?" the foreman asked Davis again.

"All right, I guess. The middle connection brass on the left side will have to be renewed and both front end main rod brasses are bad."

"Getting them made?"

"Not yet; just finished getting the rods up on this side," he explained.

EVANS left his teeth prints in his lower lip as he walked away. Three hours gone and the 5081 not one inch nearer ready to run than it had been when it was shoved in the house at one o'clock. Swearing wouldn't help matters any, though, and the foreman didn't have time to explain how a good running repair man went about getting an engine out in a hurry, and there wasn't another machinist available to put on the engine.

In the machine shop, Harper wasn't doing very much better. There weren't any tires to be turned at that particular time, and if there had been he had a man regularly assigned to run the wheel lathe. The seniority ruling would have prevented putting Harper on the job.

There was a set of driving boxes for the 5092 waiting to be bored, though, and Harper was put on that. Evans noticed that the machinist was a little nervous and acted as though he was afraid the boring mill would start snapping at him.

The foreman told one of the other machine men to show Harper about the controls on the boring mill, then Evans went to the office to take an aspirin and call the despatcher.

Harper set up the first driving box in the all-time slow record of one hour and twenty minutes. It took him about the same length of time to bore the brass off center and too large. Fortunately, the five o'clock whistle blew before Harper had time to ruin another crown brass.

Back in the roundhouse while Davis was practicing removing and replacing rods, the 5081 had been washed, filled, and fired. The locomotive had 60 lb. of steam in the boiler before anyone noticed a leaking stud. It had been marked with yellow crayon when previously inspected, but dust had made the marking dim and Davis never thought of looking the engine over for such defects.

Once again Evans had to clamp down on his lower lip to keep from saying something he shouldn't. The foreman managed to hold his temper though, and his voice was calm when he gave instruction to blow the engine down soon as possible so the stud could be burned out and a new one put in.

After Davis had finally decided that two main rod brasses and one middle connection brass were all that had to be renewed immediately, he sent his helper to inform a lathe man.

The machinist put in a little time tightening nuts here and there and then climbed up into the cab to wait for the bushings. The machine man had two or three jobs ahead and it seemed that five o'clock would get there before the bushings.

Davis seemed content to wait patiently, not because he didn't want to work, but because he didn't know what else to do. His helper, more accustomed to roundhouse work, knew better, particularly when he saw the foreman coming towards the cab.

"Tell him I've gone after a cutting torch to burn out the stud," the helper whispered hurriedly and climbed out of the cab on the side opposite the foreman.

"Is it blown down?" Evans called to the machinist.

"Yes," Davis replied, "my helper is gone after a cutting torch to burn out the stud."

"Get it soon as you can." There was more of hope than expectation in Evans' voice.

Davis evidently had not had a great deal of experience using a cutting torch. After he had put in several minutes trying to adjust the flame, his helper adjusted it for him.

The machinist put on his goggles and started to burn and the way he was using it, he could have served a year in jail putting in all his spare time trying to burn the bars. He burned all around the stud and burned the tip off the torch.

"Would you like for me to try it?" the helper asked after he had gotten another tip.

"Yes, if you don't mind. I'm a little out of practice."

The helper, although not an expert, managed to burn through the stud without enlarging the threaded hole, but it was already damaged so that it would have to be reamed and a 1⅛" stud put in where the ⅞ one had been. The five o'clock whistle caught Davis and his helper reaming on the hole.

EVANS had to have the engine. He had already put the despatcher off twice, finally telling him he could have it at 8:00. He didn't have another 5000 to run in its place. The 5093 was coming in on the train at 6:00 and it was already marked up to run east at 8:00. If he left Davis on the job alone, chances were the engine would not be finished. If he took Davis off and put another machinist on, there was chance for a grievance with perhaps claim for time. And he had already piled up more overtime than the law allows.

Between getting eaten up for excessive overtime and a terminal delay, Evans decided on the former. He told Johnson, one of his best running repair machinists, to stay and help Davis finish the 5081. What really happened was Davis stood around with his mouth open, while Johnson and the two helpers did the work. Davis was willing, but by the time he found out what to do next one of the other men had the job done.

Next day things went from bad to worse. Harper didn't ruin any more driving box brasses, but he did a fair job on the boring mill. He tried to change gears without throwing out the clutch and scattered gear teeth all over the shop.

The road foreman came in on the 5086 with a report long as a congressional investigation—engine won't steam, driving boxes pounding; rides hard; booster won't work; feedwater pump won't supply the boiler; engine lame, and two typewritten pages more.

"Are you certain it got here without falling to pieces?" Evans asked the road foreman.

"It's a miracle that it did," the road foreman replied. "And at that, we had to set out twelve loads to make it."

Evans had no comeback for that and beat it to the roundhouse while the going was good.

When the 5086 was in the house, the foreman hung the work report up in front of the engine and stood a moment thinking who to put on it. Davis was the only one he had that could be spared, but he also knew that the engine would be due for an annual inspection before Davis got it done if the machinist were left to handle it. Then Evans had an inspiration. He decided to give the machinist one job at a time and give him another one when that was done. Evans decided to have him renew the piston packing first.

Davis pitched in on the right piston first. When that one was pulled, he started in on the left one. When both pistons were out, the machinist told his helper to go to the storeroom and get two sets of packing rings.

"They didn't have but one set." The helper set a heavy package down on a vise stand.

"Why didn't you bring them?" Davis asked.

"I did; here they are." The helper tore the paper from around the package of the sectional packing rings.

"You mean the rings are in a lot of little pieces?" Davis said.

"Sure; all of the 5000's use sectional packing rings. That's the only kind we can get. Didn't you ever put any of them in?"

"No, but I guess I can." Davis picked up one of the L-shaped sections and looked at it curiously. Then he picked up another piece and tentatively placed them together.

"That's the way they fit together," the helper said. "We use a clamp to hold them in place while putting the piston in. I'll go get a clamp."

The machinist had considerable trouble getting the first ring in, but the next one went easy.

"Are you sure you got that last one in right?" the helper asked. "You know, if they are put in wrong the rings are likely to come out and cause trouble."

"Sure," Davis said. "It's in all right." But it wasn't; the sectional ring in front was turned backwards in the groove.

That might not have caused any trouble if the bull ring had not been worn, but it was almost to the limit and the cylinder was worn too, which made it worse. That allowed sections of the ring to drop down and hang on the counterbore at the front end of the cylinder.

It happened seventy-three miles out of Plainville. When the sections of the ring hung against the counterbore, something had to happen. Usually in a case of that kind the pieces of ring are smashed to bits and blown out through the exhaust. That wasn't what happened this time.

Perhaps the piston head was already cracked. Maybe the metal was crystallized. At any rate, the piston head gave way and knocked the front cylinder head off and it carried a chunk of the cylinder casting with it. None of which could have happened if the ring had been properly put in.

Evans knew in his own mind what caused the 5086 to tear up, but there was no way of proving it. There wasn't enough left of the sectional piston packing to show that there had ever been any put in, let alone prove that it was put in wrong.

IN the days that followed, the two machinists proved to be of little value to the company. Evans had just about made up his mind to disqualify them both if they didn't show marked improvement.

After the boring mill broke down, the drop-pit gang got behind waiting on driving boxes. When the machine was repaired, the foreman put Cox, the best man in the machine shop, on it and assigned a night man temporarily on the job.

Next day he sent Davis and his helper to the drop-pit. That was to be the machinist's last chance to make good. If he fell down on that, Evans decided to get rid of him, even if he had to reduce the force to cut the two new men off.

But Davis didn't fall down. No one in the roundhouse at Plainville had ever seen parts of a locomotive put in place in as short time. The engine was finished a full day sooner than Evans had hoped. When it made a good run without running hot, all thoughts of disqualifying Davis vanished.

He was not quite so fortunate in finding a place where Horton fitted. One day when the regular wheel lathe man was off, Horton ran the machine and did good work. He is learning on the other machines and in time will make a good all-around machine man, but as Evans says, he wanted mechanics, not apprentices.

A boilermaker and a pipe man were the next two mechanics to report for work at Plainville. When they showed up, Evans called them in the office to talk to them. The pipe man's experience was O.K., and he turned out to be a good man on running repair.

"What kind of experience have you had?" Evans asked the boilermaker.

"Laying out mostly," the boilermaker replied. "I've been on the lay-out job nearly ten years."

"Can you do electric welding?"

"No, I never did, but guess I could learn," the boilermaker said.

"Ever do any hot work?"

"Very little; in fact, I've done very little repair work of any kind. I learned the trade in a boiler shop building boilers and I've been on lay-out work most of the time I've been with the railroad."

"Well, I don't know;" the foreman shook his head, "I'm satisfied you'll have to go on nights in a few days. The man now on nights has been wanting to come on days for some time. You'll have a sweet time on that job. I'll try you on days a while."

Two or three days later the master mechanic called Evans in the office. "We've increased the force four mechanics and four helpers, yet you are running up more overtime than ever, and I can't see that our power is getting in any better condition."

"That's right," Evans agreed. "But the trouble is, the new men are all Chick Sales mechanics."

"What do you mean 'Chick Sales' mechanics?" the master mechanic asked.

"They are all specialists. Take the boilermaker that came in a few days ago. He's a lay-out man. Chances are he could lay out and build a fire box quick as the next one, but the trouble is we don't build fire boxes here."

"Why don't you disqualify them?"

"If I did we might get some that are worse. They'll all probably be good men with a little roundhouse experience, and if we ever did need good men, we need them now."

The Renewal of Fireboxes

(*Continued from page 545*)

The boiler is placed on rollers upside down, after which the firebox is dropped in place and the mud ring is set in. The firebox is lined up in the shell and the water space divided equally and sufficient staybolts are applied to hold the firebox in position. The mud ring is fitted, the corners are laid up both inside and out, the holes are reamed, and mud-ring rivets are applied.

All staybolts and radials are applied to within one row of the outside syphon flange weld. On locomotives with two or three syphons in the firebox, it is very difficult to drive the upper rows of staybolts and radials with the syphons in place. For this reason we apply all staybolts and radials before applying the syphons. The syphons are then set in place, fitted up and made ready to weld. They are welded down-handed from the fireside. After all the seams have been completely welded, the boiler is turned right side up, and the seams are back-welded on the water side. The tubes and flues are then applied and the boiler is tested and made ready to transfer to the erecting floor to place on the frames.

Report by H. L. Livers

Boiler Shop Foreman, Texas and Pacific

The laying out of all firebox sheets is done by templates. Instead of drilling one sheet, we stack from three to ten sheets as the need may be and, using a marked sheet as a template, drill through all the sheets. After sand blasting, an inspection of the wrapper sheet, back head and throat sheet is made, and all defects are repaired before the firebox is applied. All staybolt holes are checked and holes larger than $1\frac{1}{16}$ in. are reduced to 1 in. by electric welding.

The wrapper sheet is rolled and the sheets are fitted in the mud ring. The sheets are laid up and the rivet holes are reamed. The firebox is placed on end to drive the rivets, starting in the center and riveted to within six rivets from the mud-ring corner. After the rivets are driven, the firebox is placed on its side and the mud-ring corners are laid up. The six remaining rivets are driven and all mud-ring corners are welded 12 in. above the mud ring. All firebox rivets are double gunned. The firebox is then caulked on both sides and fitted into the boiler shell.

In boilers with combustion-type fireboxes, we renew these by an entirely different method. These locomotives have a four-wheel trailer frame. These are run out when the wheels are removed, giving ample room to apply the firebox sheets without removing the boiler from the frame.

After removing the firebox staybolts, radials and flexible bolt heads, the firebox is sandblasted and the necessary repairs are made. The syphons are fitted to the crown sheet, and the crown sheet is placed in the shell using chain blocks and holding in place by long bolts through the roof sheet. Then the door and inside throat sheet, back flue sheet, combustion chamber, and side sheets are fitted in the order named. All seams are butt welded, except the back flue sheet and across the top of the door sheet.

Discussion

The discussion of this subject indicated that there was considerable difference of opinion on whether the boiler should or should not be removed from the frame for the renewal of the firebox. One member stated that at a time study made by the railroad which he represented showed a saving of $250 was obtained by removing the boiler from the frame when doing this repair job. Furthermore, he said, there is less interference between the boilermakers and the machinists in performing their duties.

Another member referred to the better work that can be done when the boiler is removed from the frames. He explained that this procedure permits the placing of the firebox in the proper position for welding.

Another speaker said that they had found it more economical to apply new fireboxes without removing the boilers from the frames. It was pointed out that the proper method to be used may depend upon the available shop facilities and is also influenced by the design of the locomotive under repairs.

Methods for Welding Locomotive Frames

In spite of the rapid increase in the amount of welding in the railroad shop today, welding locomotive frames still occupies an important place. Not only is it necessary for the welder to get a nearly perfect weld, but the frame must be correctly prepared. There are a few fundamentals that are imperative for good frame welding.

Let us first consider a locomotive with a broken top frame rail just ahead of the main drivers. This break

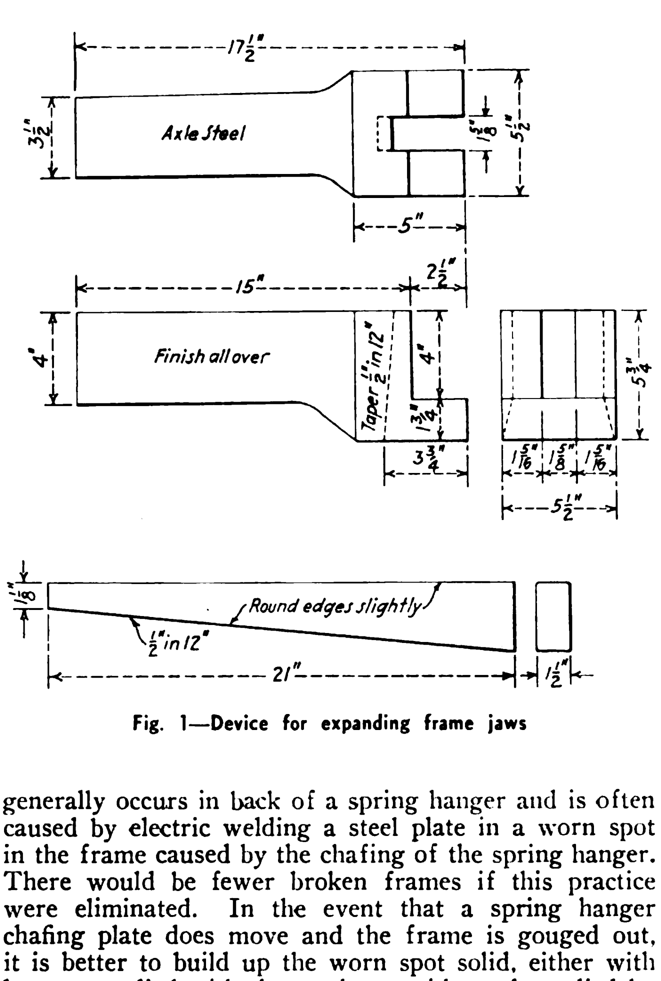


Fig. 1—Device for expanding frame jaws

generally occurs in back of a spring hanger and is often caused by electric welding a steel plate in a worn spot in the frame caused by the chafing of the spring hanger. There would be fewer broken frames if this practice were eliminated. In the event that a spring hanger chafing plate does move and the frame is gouged out, it is better to build up the worn spot solid, either with bronze, applied with the torch, or with steel, applied by electric welding.

Although it would seem impossible to expand a frame break ¼ in. it is quite simple when the proper procedure is followed. After the wheels have been dropped, the frame wedge belonging in the jaw is placed in position. This provides a straight surface to jack or wedge against. Next, the expander, shown in Fig. 1, is inserted in the jaw in line with the bottom rail of the frame. Before going any further, the frame must be trammed so that the expansion may be measured so as to know when the proper amount has been reached. This amount varies with the size of the frame. It is well for the operator to base his calculations on a 5-in. square section. This size requires exactly ¼ in. Naturally there must be slightly more for larger sections and less for smaller ones. If the proper amount of expansion cannot be secured by the above method, it is a simple matter to cut the pedestal.

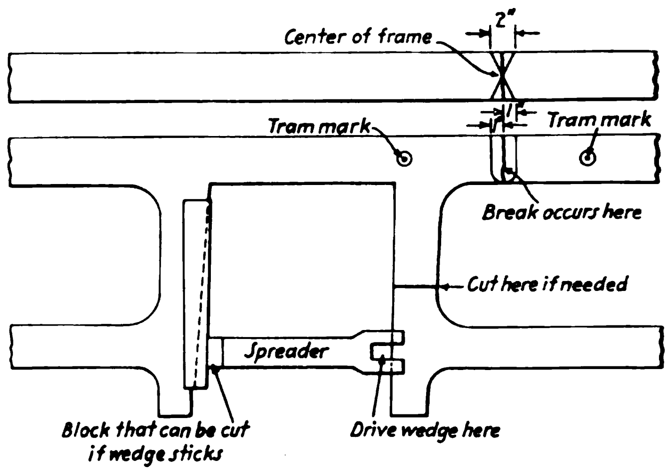


Fig. 2—Method of spreading jaws and scarfing the break

After the frame is expanded, it must be scarfed out for welding. There are numerous ways of doing this, but the generally accepted one is as follows: Find the center of the frame on top and center punch it. Then center punch a line down the face of the frame 1 in. each side of the break. When the bottom is reached curve the scarf in toward the break so that the bottom edge of the frame rail remains intact. Curving the cut in at the bottom saves the bother of putting a plate on to start the weld. The scarf should then be chipped free of all oxide. This method is shown in Fig. 2.

It is customary to have at least three operators on a frame weld of any size. While this is not absolutely necessary, it is a good plan because it has been proved that a tired operator is quite apt to be a little careless in the application of the weld metal. The extreme heat and rarefied air adjacent to a heavy weld rapidly sap the vitality of a welder and cause him to tire quickly. To insure the best type of welding, operators should not be permitted to weld on heavy sections more than one hour at a time. Fig. 3 shows a cooler designed to add to the comfort of the welder.

There are many kinds of frame breaks but this is typical and with a little ingenuity the operator should be able to arrange the expander to give the most expansion with the least effort in every case.

There are times when a frame must be repaired by some method of welding that does not require so much expansion. In such a case bronze may be the solution.

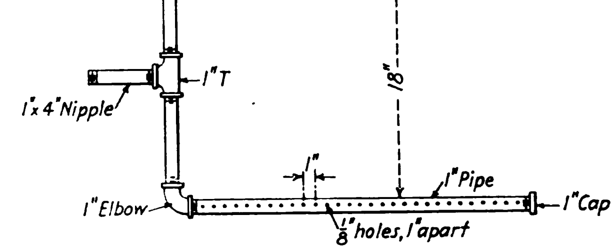


Fig. 3—Air cooling jets

Bronze rod has a tensile strength suitable for this application and can be used with the assurance of a satisfactory result. When a locomotive frame is broken in an emergency, it becomes necessary to repair in the least possible time. The frame may be cut out and filled with bronze without any expansion or removing any parts. Of course, this temporary repair is removed at the earliest opportunity and a more permanent weld substituted.

Another solution is welding with the shielded-arc process, where little expansion is required and if a few simple rules are followed excellent results may be expected. The scarf must be free of all oxide; a good grade of rod must be used (there is no economy in cheap welding rod), and all slag must be removed from each layer. It is a good plan to peen each layer with an air hammer. This helps to remove some of the strains set up by the contraction of the weld metal. Finally, the weld should be annealed by heating to a cherry red with a charcoal fire, or similar method.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Method for Rolling Crown and Firebox Sheets

Q.—What is the proper way to roll the crown and sides of a firebox where the crown and sides and the combustion chamber are to be made in one piece?—J. S.

A.—The following method is used in rolling the crown and sides on fireboxes having combustion chambers.

Figs. 1 and 2 illustrate the crown and sides and combustion chamber as submitted in the question. The first operation is to roll the bottom of the combustion chamber as designated by *A-A* in Fig. 2. This is done with the use of filler strips as illustrated in Figs. 1 and 3. The filler strips are generally ⅜ in. thick and a sufficient number are used so that the crown and sides will pass freely through the rollers, the filler strips and combustion chamber being rolled to the desired diameter.

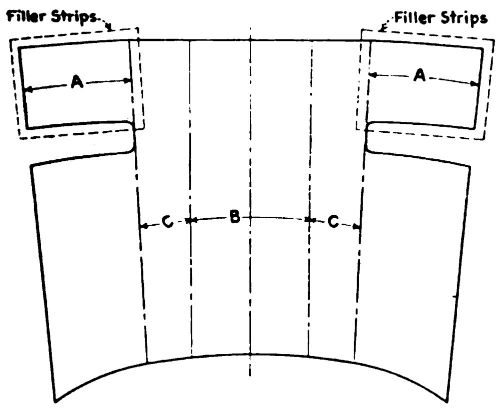


Fig. 1

The second operation is to roll the corner radii on each side as designated in Fig. 2 by *C*. These radii are rolled the entire length of the sheet.

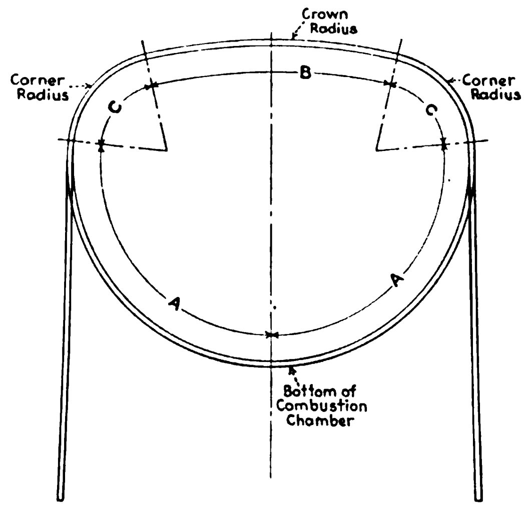


Fig. 2

The third operation is to roll the crown radius *B*. This radius being rolled for the entire length of the sheet.

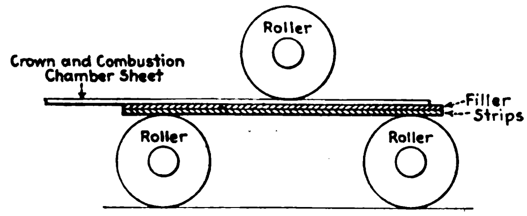


Fig. 3

Repairs to Sheets When Changing Types of Stokers

Q.—We are removing several Duplex D-2 stokers from Pacific type locomotives and applying Standard HT stokers in their place. Should a new firedoor sheet and backhead be applied to the boiler when making this change or can the present sheets be altered to suit?—L. J. R.

A.—The application of a new firedoor sheet or backhead when changing from D-2 to HT stokers should depend entirely upon the condition of these sheets at the time the stoker change is to be made. The firedoor sheet and backhead should be thoroughly inspected for checks and cracks in the knuckles and staybolt holes and should they be found to be in bad shape, the sheets should be renewed at the time the stoker change is made.

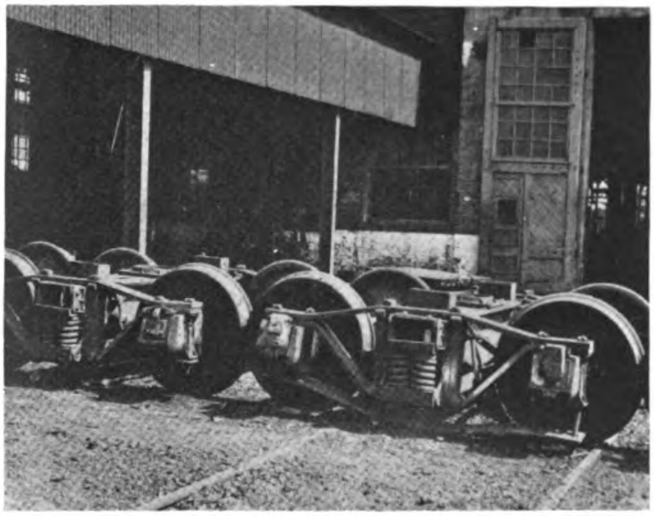
Should it be found that the knuckles were checked and cracked only along the sides, it would only be necessary to apply a half firedoor and backhead, extending them up to the top of the staybolts, thus renewing the sheet up to and above the old Duplex stoker tube holes, and still not disturbing the backhead bracing.

Should it be found that the backhead and firedoor sheets are in good condition, the alterations could be made by cutting the sheets, removing a section of plate including both stoker tube holes and firedoor hole and then apply a welded or riveted patch having a firedoor hole suitable for use with the HT stoker.

With the Car Foremen and Inspectors

New Haven's Readville Shop Rebuilds

16,400 Arch Bar Trucks

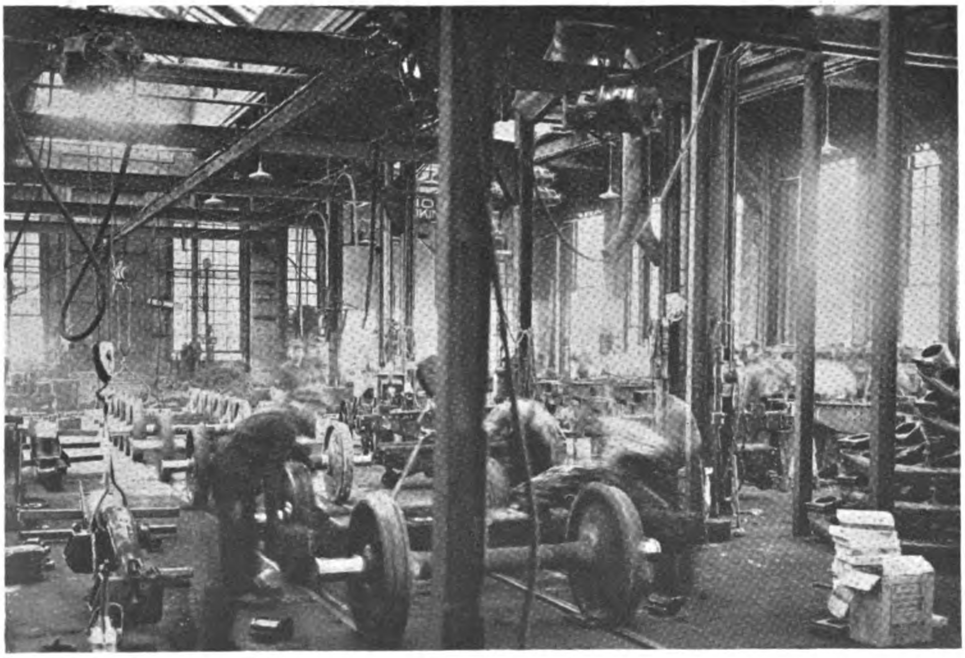


Old arch bar trucks on the stripping tracks. The journal box bolts have been cut through preparatory to dismantling the trucks

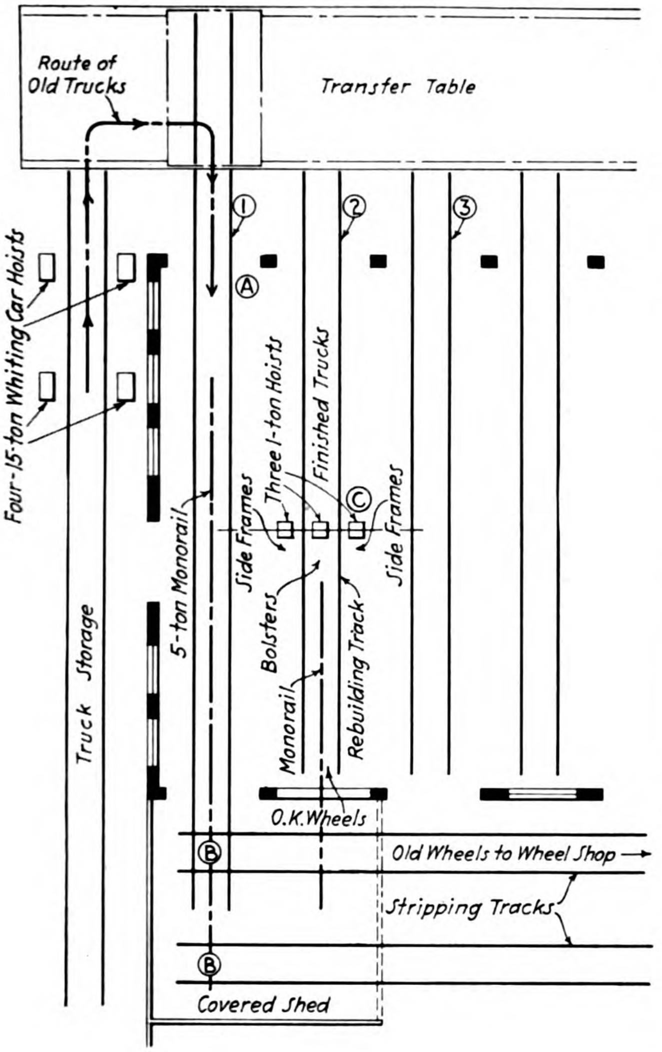
In accordance with requirements of the A. A. R. affecting the discontinuance of arch bar type of car trucks, the New York, New Haven & Hartford set up a shop operation at its Readville, Mass., shops for the rebuilding of these trucks on a quantity production basis. After the necessary facilities were installed, the job was started in May, 1936, and when the schedule had been completed in August, 1939, a total of 8,200 car sets of trucks had been rebuilt into modern cast-steel side frame types. The average daily output of the truck rebuilding department was from 24 to 28 finished trucks.

Reference to the drawing will show the layout of the facilities which involved two inside shop tracks at one end of the shop building and one track outside of the building. The outside track is a through track across the transfer table and immediately adjacent to the corner of the shop, nearest this track and the table, four 15-ton Whiting car jacks were installed with unit electric control. The truck rebuilding job was scheduled to fit in with a freight car repair program so that the cars to be repaired were delivered at the truck rebuilding location with the old arch bar trucks still under the cars. The cars were then jacked up, the old trucks removed and the new trucks installed under the cars, which were then moved into the repair shop.

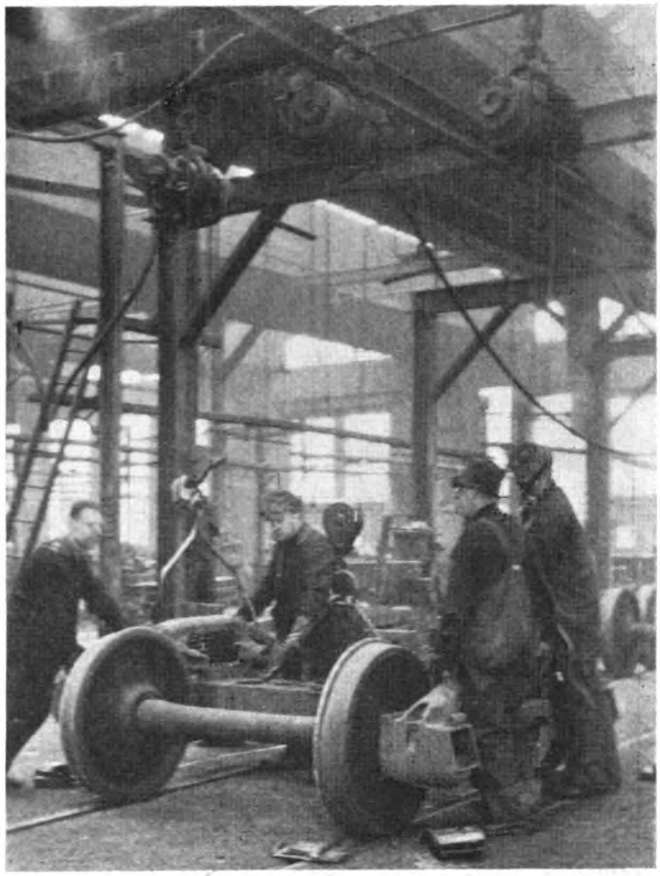
As the old trucks were removed they were rolled back onto the transfer table and immediately moved to position *A* on shop track No. 1 where they were picked up by an overhead monorail electric hoist of 5 tons' capacity and moved through the shop to the covered shed at the opposite end of the building and placed on stripping



General view inside the shop taken from the assembling location looking toward the stripping shed. The incoming wheels are seen on track No. 2; the bolster repair location, at the right, on track No. 1 and the truck assembly in the foreground. The bolster is in place and the side frames are on the hoists ready for application



Layout of truck rebuilding shop

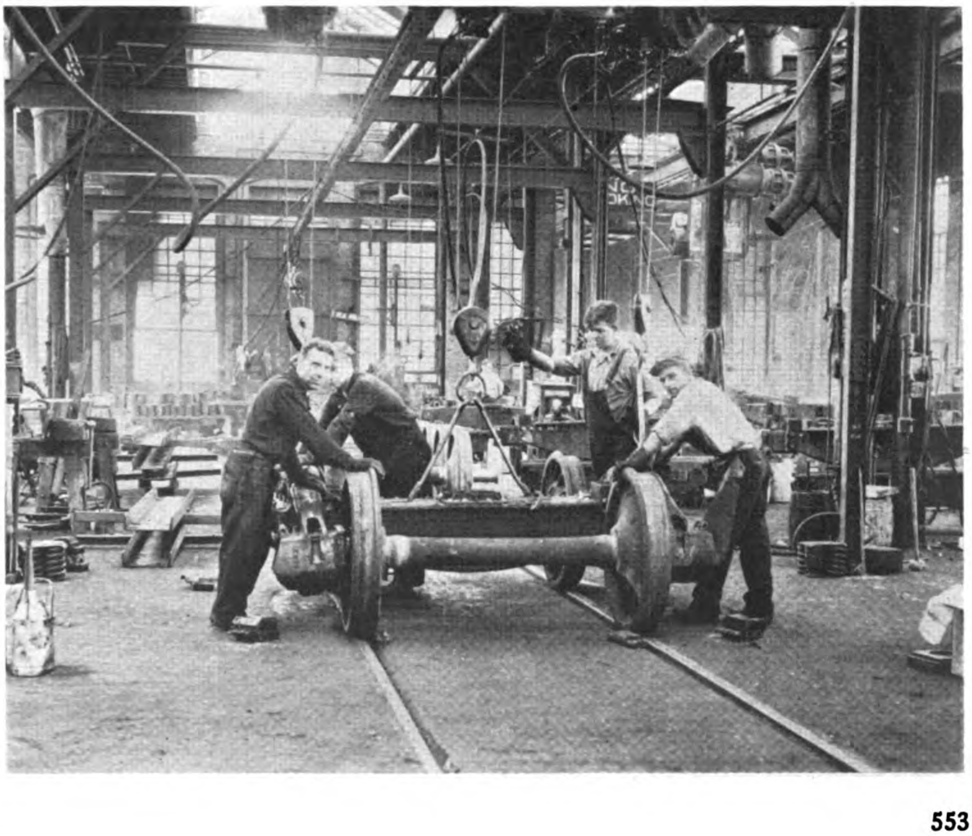


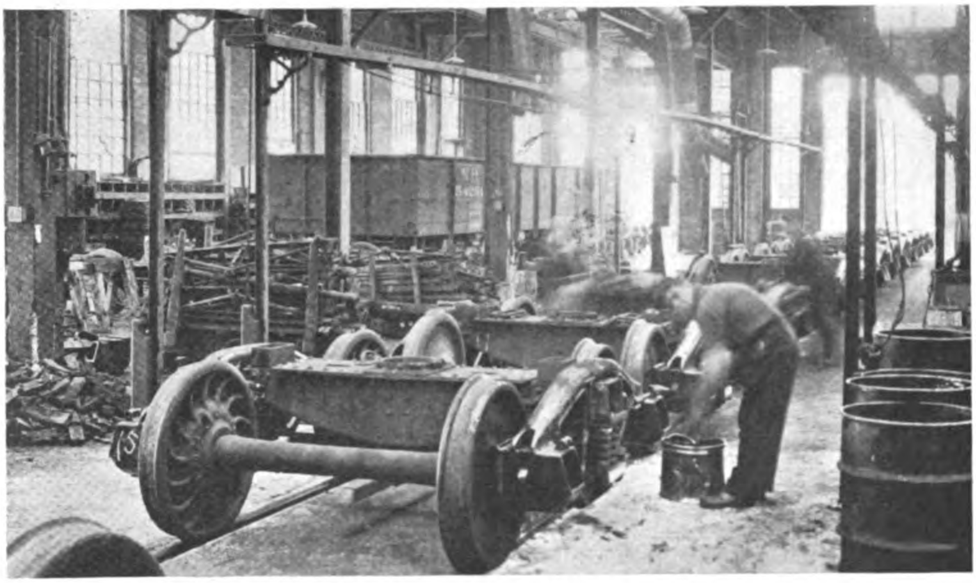
Putting the side frames in place. The three overhead hoists are shown in their respective positions on the transverse runway from the side frame storage positions

tracks at the position marked *B*. These stripping tracks are of the full length of the shop building and had truck storage capacity sufficient for two or three days' operations.

All of the trucks were stripped outside of the shop.

At this stage of the assembly, the repair crew was getting ready to slide the spring plank under the bolster





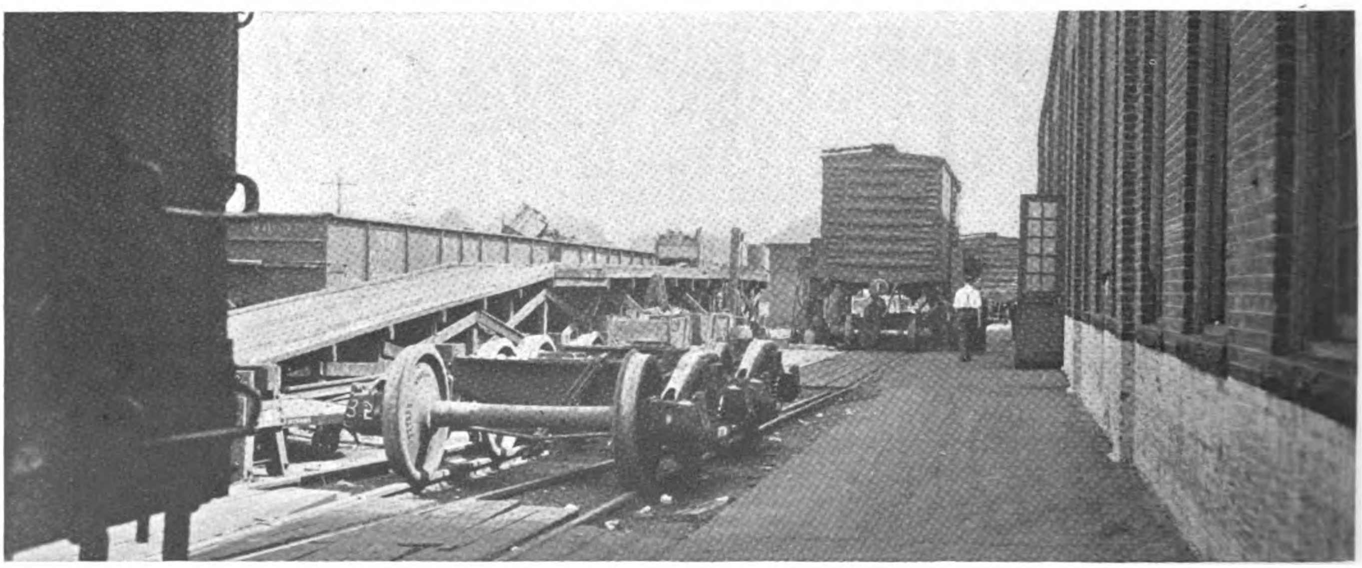
Top—After the trucks were assembled, the journal boxes were packed. A line of completed trucks is shown in the background on track No. 2. Center—The completed trucks were then moved out onto the transfer table. Bottom—This is the supply track outside the shop where the cars were brought in with the old trucks and jacked up on the Whiting hoist. The new trucks were placed under the car and it was then moved into the shop for repairs

The first stripping operation was to have a workman go along the line of old trucks and burn off the journal box bolts with an acetylene torch. Then the old trucks were moved under the shed to position *B* and completely dismantled. The old bolsters were taken into the shop for use in the rebuilt trucks; the wheels were inspected and those meeting the requirements for further service were placed in the shop on track No. 2—the condemned wheels being sent to the wheel shop; the spring planks were sent to the car department machine shop in an adjacent building for drilling and the remainder of the parts of the old trucks were set aside for disposition as scrap or otherwise.

The alteration work on the old bolsters consisted of checking up to make sure that the wear plates were in good condition for further service and, if not, they were either renewed or built up by gas welding. The spring planks were sent to the machine shop and drilled to fit the new cast-steel side frames.

Assembling the New Trucks

All of the assembly work was carried out on shop track No. 2. A supply of wheels was maintained on this track and one pair was placed in position at *C* under the three one-ton hoists. The center one of these three hoists



was fixed in position laterally and the two outside ones moved on a runway at right angles to the shop track. After the wheels were placed, a bolster was brought from the pile adjacent to the assembly location on a special wheeled truck to a point where it could be picked up by the center one of the three hoists. It was held at the proper height by this hoist while two side frames were picked up by the two outside hoists and moved in toward track No. 2. By means of these three hoists, the side frames, bolster, and wheels were placed in the proper position and the journal brasses and wedges were applied. The next step was to slide the spring plank under the bolster and then insert the coil spring nests.

The truck was then moved along the assembly track to the next position where the journal boxes were packed, brake beams, hangers, safety guards, and bottom connectors applied. As the trucks were completed, they were moved out of the shop on track No. 2 and transferred to the outside supply track where they were either applied under incoming cars or stored until needed.

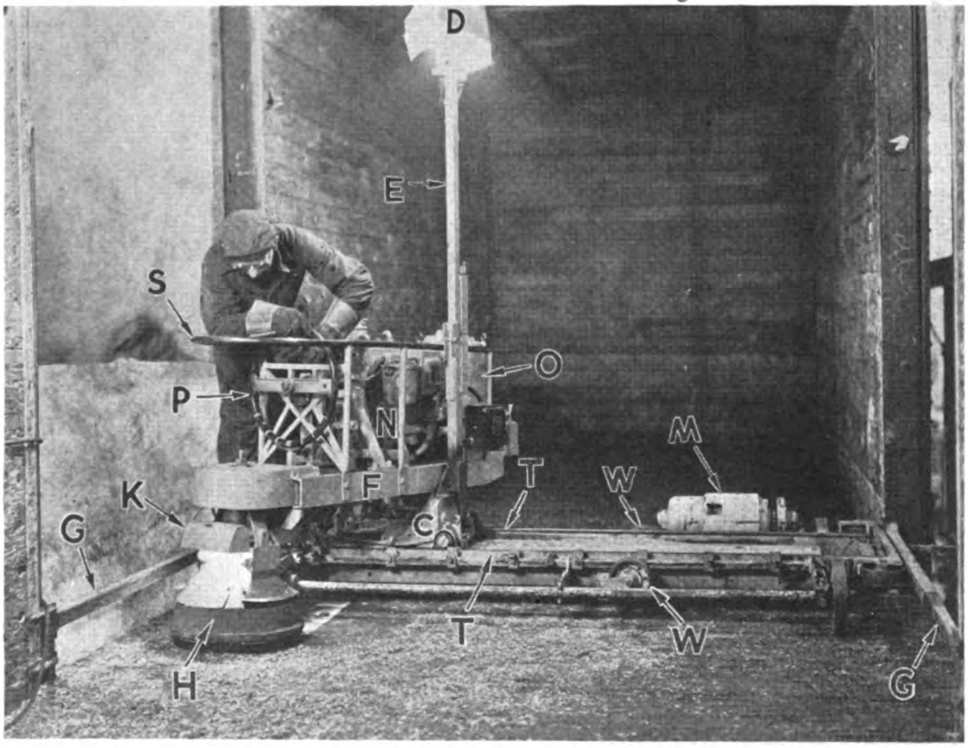
Car-Floor Finishing Machine

The illustrations show a new machine, recently developed by the Nordberg Manufacturing Company, Milwaukee, Wis., for re-surfacing or smoothing badly-worn and rough box-car floors. The machine is powered by electricity and weighs approximately 2,000 lb. Normally, it would require a crew of three men to operate: a runner, a helper and a sweeper. After the machine is set up in the car, the runner operates the machine, the sweeper keeps the floor clear of the cuttings, and the helper changes and sharpens the knives in another cutter head to be ready for the next car. In addition, some time must be spent by two or three men in driving down nails and taking out the center floor bolts if it is a bolted floor. The bolts in the ends of the boards are left in place. The estimated cost of surfacing a car floor with this machine at the rate of one floor per hour is less than $12.00.

The knives which do the surfacing are so arranged in the revolving cutter head that they will make a cut of but 1/16 in. to 1/8 in. as desired, and not go deeper. The knives are made of high-speed steel and may hit nails or bolts without breaking or seriously dulling the knives. The heads are changed for every car, about 10 or 15 min. being required to resharpen and place the knives in the extra heads furnished for this purpose. Since the knives are only slightly dulled by dirt, etc., embedded in the surface of the floor, it is possible in many cases to use a set of knives for two cars but generally, a better job will be accomplished by starting every car with sharpened knives.

A good job well done by a careful operator will leave the floor with fewer irregularities or variations in height of the boards than with a new floor. For exceptionally smooth jobs, some roads may desire to finish the floor with a sanding machine following the car floor surfacer. Cars that have been badly fouled with oil, creosote and green hides are said to have been made fit for any kind of lading after being re-surfaced.

Referring to the illustrations, the general construction and method of operation of the machine will be apparent. It is normally moved about the car shop on a platform truck of the same height as the car floor, being pulled into the car with the weight resting largely on two retractable transverse wheels *WW*. Once in the car, it moves lengthwise of the car floor on four wheels as illustrated, being driven by electric motor *M* and guided by four horizontal rollers bearing against the sides of the car and against door guides *GG* when passing the doorways. The cutter head, revolving at high speed under guard *H*, is driven by pulley and V-belt connection to a 10-hp. electric motor *N*, the entire drive mechanism and controls being built into a steel frame *F* which can be rotated through 360 deg. and is supported on carriage *C* equipped with four small flanged rollers for power-driven transverse movement along track *TT* on the main ma-

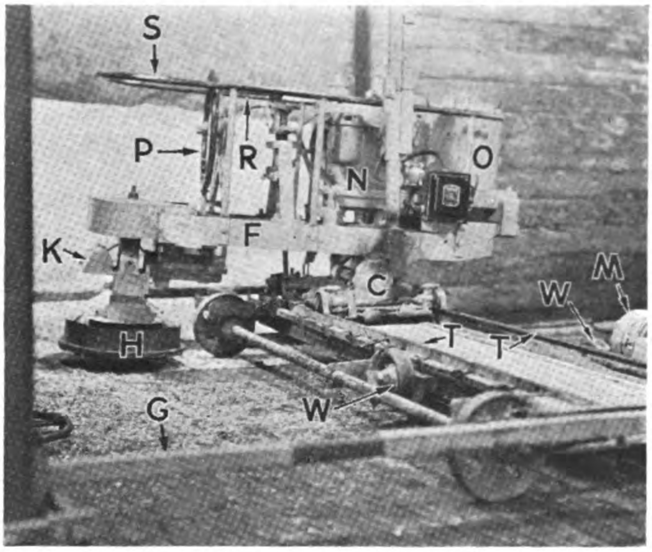


Nordberg car-floor finishing machine resurfacing the floor of a box car at the Milwaukee shops of the C. M. St. P. & P.

chine frame. Frame F can be indexed and held in any desired angular position for cutting in doorways or corners of the car and carriage C can also be locked at any position necessary along the main frame.

For satisfactory operation of this machine, it is very important to have complete flexibility for raising, lowering and tilting the cutter head on both the longitudinal and crosswise axis. Two short levers under the operator's left hand (shown at R in one of the views) control the movement of the machine along the car floor and lower the cutting head. Hand wheel P tilts the cutter head as necessary to feather the outside cut where end bolts in the floor boards are not removed. Guard rail S serves to steady the operator who rides on the machine. General illumination is supplied by light D on power intake standard E which can be lowered when moving the machine into the car. The electric cable passes from the top of this standard through a pulley temporarily secured in the top of the door opening and has a counterweight on the outside which enables the cable to lengthen or shorten with movement of the machine, but always keep taut and hence up out of the way. The auxiliary light K illuminates the floor around the cutter.

The cutter head floats on the car floor so that it follows the rolls and sags on the original surface. The six ¼-in. by ⅞-in. high-speed steel knives or cutters are



Another view of the car-floor finishing machine showing additional details of the construction

rigidly set in the head at an angle of 25 deg. and can be quickly and easily adjusted by a special jig to project uniformly 1/16 in. to ⅛ in. below the head so as to give the limited depth of cut desired. The machine travel is 50 ft. per min. and a cut about 16 in. wide is taken each time the machine moves up and down the car with the cutter head in operation. Cuts lengthwise of the floor boards may be taken when desired by means of the power drive to carriage C.

This car-floor finishing machine is of exceptionally rugged design and the performance when hitting nails is quite remarkable. It simply snips them off or shears them lengthwise and, in fact, seems to "thrive on them." The cutter head is a strong steel casting, the knives well backed up at the rear and when run into a solid obstruction like a floor bolt the machine simply stalls. The machine, illustrated, has been largely developed and is now in use at the C. M. St. P. & P. car shops at Milwaukee, Wis.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Joint Evidence Necessary to Claim for Improper Repairs

The Southern Pacific repaired P. H. & D. car No. 1226 on October 1, 1936, by applying one S. H. A. A. R. cast-steel coupler yoke and one S. H. A. A. R. 5-in. by 7-in. by 6½-in. type D coupler body. The Mather Stock Car Co. declined to accept the charge for these repairs. It stated that car No. 1226 carried a non-A. A. R. cast-steel yoke, 1⅛-in. by 5-in. horizontal cross key, and 5-in. by 7-in. by 6½-in. type D couplers at each end and that the proper substitute for this type of yoke is an A. A. R. wrought-iron yoke as provided by interpretation No. 11 of Rule 17. The Mather Stock Car Co. contended that the Southern Pacific could either have replaced the parts in kind or could have applied the A. A. R. wrought-iron yoke and, having failed to follow either of these methods of repair, it should withdraw its charge for non-permissible repairs. The Southern Pacific stated that in order to substantiate a claim for wrong repairs, joint evidence was necessary as provided by Rule 12 and contended that as this claim was not supported by the proper joint evidence, the charges as rendered are proper and should not be cancelled.

In a decision rendered November 17, 1938, the Arbitration Committee stated: "The statement of the Mather Stock Car Co. contains no evidence to substantiate the claim that the cast-steel yoke applied did not conform to the standard of the car with respect to pocket and keyway dimensions and to substantiate its claim that the repairs were improper, joint evidence should be furnished. The contention of the Mather Stock Car Co. is not sustained."—*Case No. 1768, Mather Stock Car Co. versus Southern Pacific.*

Repairs Unwarranted—Direct Connection with Owner

The Southern made heavy repairs to 11 Interstate cars at its Spencer, N. C., shops during the month of April, 1938. The Interstate took exception to the repairs to these cars, claiming that the repairs were in violation of A. A. R. Rule 1, paragraph b, as the cars were in condition to have moved home empty without any repairs or with only temporary repairs, as the Southern has a direct connection with the Interstate at Appalachia, Va. The Southern did not consider that there was any violation of the Rules of Interchange in the repairing of these cars as it was its understanding that Rule 1 (b) refers to a direct connection to the home line at the point where the car is located in bad order and does not contemplate handling of the car several hundred miles to effect delivery to the car owner. The railroad claimed the condition of these cars would not permit the making of temporary repairs at a reasonable cost to put them in condition to move over 300 miles.

In a decision rendered November 17, 1938, the Arbitration Committee stated: "Since the Southern has

direct connection with the car owner, the extent of repairs made was in violation of Rule 1 (b) and the bill, therefore, should be cancelled. If temporary repairs were necessary to move the cars safely to the interchange point, authority to bill could have been requested in accordance with Rule 21 (c). The principle of decision 1760 applied."—*Case No. 1769, Interstate versus Southern.*

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

490—*Q.—What is the purpose of this choke?* A.—In service position it serves to retard the flow of air to the chamber over the application valve, permitting the pressure underneath to lift the piston and unseat the application valve.

491—*Q.—Explain the operation of the relay valve in release position.* A.—The supply-reservoir air flows through choke No. 12 to the spring chamber back of the application piston, balancing the pressure on both faces of the piston. With the brakes released there is no pressure in the displacement reservoir and chamber *B* on the face of the relay piston. This piston is in release position and the application valve and piston seated, being held in that position by two springs. The exhaust valve and piston are in their lower position, opening chamber *A* and brake cylinders to the exhaust passage.

492—*Q.—Explain the relay valve in applied position.* A.—When a brake application is made, air from the displacement reservoir builds up in chamber *B* on the face of the relay piston, moving it and the attached level upward. The application-valve spring resists the first movement and thus fulcrums the lever at the right and between the application-valve stem and the adjusting screw. The left end of the piston lever moves upward, lifting the exhaust-valve stem, seating the exhaust valve on its seat on the exhaust piston, moving the piston against its bushing seat, in this way limiting the upward travel of the left end of the lever, closing the connection between the brake cylinder (chamber *A*) and the exhaust passage. As the piston movement continues upward, the level becomes fulcrumed at the left end, lifting the application valve stem, and unseating the application valve. This permits the supply-reservoir pressure above the application piston to flow into chamber *A* and to the brake cylinder faster than the rate permitted by choke No. 12, and the reduced pressure above allows the supply-reservoir pressure underneath to lift the piston. This permits the supply-reservoir pressure to flow to the brake cylinder.

493—*Q.—Describe the operating in lap position.* A.—The brake-cylinder pressure continues to build up in chamber *A,* and on the back of the relay-valve piston until it equals the displacement-reservoir pressure in chamber *B* on the face of this piston. The application valve and piston are returned to their seats by the two springs, moving the contacting stem, the right end of the fulcrum lever and relay-valve piston downward. During this movement the left end of the lever fulcrums on the exhaust-valve stem, holding the valve seated.

494—*Q.—Does this arrangement maintain the brake-cylinder against leakage?* A.—Yes.

495—*Q.—How is this done?* A.—Any reduction in pressure in chamber *A* (brake-cylinder pressure) below that in the displacement reservoir on the lower relay valve piston face (chamber *B*) causes the fulcrum lever to move upward, opening the application valve and allowing the supply reservoir pressure to flow to the brake cylinder until the balance is restored.

496—*Q.—Explain the operation during a partial or complete release of the brake cylinder pressure.* A.—When the displacement reservoir pressure on the face of the relay piston is reduced, the brake cylinder pressure on the back of the piston causes it to move downward and, as the lever is fulcrumed at its right end, it moves the left end of the lever downward, allowing the exhaust valve to open. This allows the brake cylinder pressure to flow past the exhaust valve, balancing the pressure on the exhaust piston, permitting it to open easily. This allows the brake cylinder pressure in chamber *A* to flow through the exhaust passage.

497—*Q.—Does the brake cylinder pressure release completely?* A.—Not unless the displacement reservoirs pressure is completely released.

498—*Q.—What causes the relay piston to move to lap position?* A.—If only a partial release of the displacement reservoir pressure is made, the brake cylinder pressure will continue to flow to the exhaust until the pressure on the back of the relay piston is lower than that on the face at which time the piston moves upward to lap position, seating the exhaust valve and piston and cutting off further flow of brake cylinder pressure to the exhaust.

499—*Q.—What permits accurate graduations during the various operations?* A.— The exhaust and application require little force to move them so that the relay valve as a whole is very sensitive.

500—*Q.—Where is the A-4-A relay valve used instead of the B type?* A.—On cars having the foundation brake rigging designed to provide the required high-braking force for ultra high-speed service.

501—*Q.—What braking ratio does it provide?* A.—The standard maximum braking ratio of 150 per cent for conventional passenger service.

502—*Q.—Does this require any changes in the brake rigging?* A.—No fundamental changes are required.

503—*Q.—How do the pipe connections compare on the two types of relay valves?* A.—The pipe connections between the control valve, the combined reservoir and the relay valve are the same for either relay valve.

504—*Q.—What does the A-4-A relay valve consist of?* A.—It consists of a self-lapping portion like that of the *B* type, except that the piston embodies a release spring, and faces a large diaphragm.

505—*Q.—What acts on the large diaphragm?* A.—A small diaphragm acts on the large one through a suitable follower.

506—*Q.—Where does the chamber on the face of the small diaphragm connect?* A.—Chamber *A,* on the face of the small diaphragm, is connected to what is known as pipe *16,* thence to the displacement reservoir.

507—*Q.—What acts on the small diaphragm?* A.—The displacement reservoir pressure acts on the small diaphragm which in turn acts through the follower and large diaphragm to operate a level which reproduces the proper proportion of brake cylinder pressure.

508—*Q.—How does the self-lapping unit compare with that of the B type?* A.—It operates as described for the B type except that it is actuated by a diaphragm pile instead of a piston.

509—*Q.—How do the two types of relay valves compare as regards reproduction of brake cylinder pressure?* A.—The self-lapping unit of the Type B valve reproduces brake cylinder pressure equivalent to the displacement reservoir pressure. In the A-4-A valve, the area of the small diaphragm being less than that of the larger one a proportionately lower brake cylinder pressure is produced on the large diaphragm by a given displacement reservoir pressure on the small diaphragm.

High Spots in
Railway Affairs . . .

Minimum Wages On the Railroads

A United States Department of Labor statement indicates that of the 1,200,000 wage earners on the railroads, approximately 100,000 receive less than 40 cents an hour, these being in large part maintenance of way workers. The Wage and Hour Division announces the appointment of a committee of 12 members to study the problem and recommend a minimum wage for the railroad industry, up to 40 cents an hour, which will not substantially curtail employment. It appears that the Economic Section of the Wage and Hour Division has already made an extensive study of hourly wage rates, and this will be placed at the disposal of the committee. When it files its minimum wage recommendation, a public hearing will be scheduled by the Administrator, after which he may approve or reject the recommendation.

River Transportation Expensive

Clyde M. Reed, United States Senator from Kansas, was in fine fettle when he spoke to the National Industrial Traffic League in Chicago on November 21. He urged the league to support the Wheeler-Lea Bill, which he suggested was "a start toward a national policy in dealing with transportation". He declared that "inland waterway transportation is not low cost transportation; it is high cost transportation as compared with the highways or the railways. The only reason for lower charges is the subsidy paid by taxpayers out of the public treasury. Without such a subsidy, inland waterway transportation could not exist for a month." He spoke of "inland waterway racketeers" and made this significant statement: "When we come down to talking about public morality in the handling of public money, I find it difficult to make a distinction in my mind between Tom Pendergast taking a million dollars out of the Kansas City treasury, and Missouri River promoters inducing the United States to waste two hundred million dollars trying to make the Missouri River navigable. It can't be done. Even if it could be done successfully, the benefit would be nothing in comparison to the money spent."

Ickes Fulminates On Road Hogs

Harold L. Ickes, Secretary of the Interior, surely "said a mouthful" when he recently addressed the American Automobile Association. In speaking of road taxes he said, "We have been digging into our pockets to build boulevards for trucks." He characterized the truck driver as one who drives a monster at reckless speed, regardless, generally speaking, of the rights of the mere motorist. "I have promised some day," said Mr. Ickes, "to give myself the pleasure of driving down a truck-infested road in the biggest armored tank that I can find and bumping these pests from the road, regardless of where they may light." * * * As the motorist ventures forth with his family to drive a few miles on a pleasant Sunday afternoon, he not infrequently finds himself in a situation that Tennyson might have described in this fashion:

> "Trucks in the front of him;
> Trucks in the rear of him;
> Trucks on each side of him;
> Back-fired and lumbered."

While the state of mind of the motorist, thus beset, might be written thus:

> "His not to reason why,
> His but to pass and die.
> Into the mouth of death,
> Into the fumes of Shell,
> Rode the encumbered."

A Sad State of Affairs

"The American people have not paid a fair price for transportation service when measured in terms of what they have been required and willing to pay for other essential services and products," said William J. Williamson, general traffic manager, Sears, Roebuck & Company, before a recent meeting of the Women's Traffic Club of Greater New York. He pointed out that, "A survey of 18,000 truck lines covering the first nine months' operation in 1938 revealed an operating ratio of 99.65 per cent; in other words, the actual cost of operations alone took practically all the income, leaving nothing for interest, dividends, or new capital. Privately owned for-hire water carriers have been in constant financial distress for the last 25 years. Recently much of the commercial package transport on the Great Lakes has been abandoned. Only a few of the intercoastal lines are operating at a profit. Were it not for government promotion and subsidy, the air lines could not exist on the basis of their present rates. Railroads as a whole had a deficit in 1938 of 123 million dollars." According to Mr. Williamson, this "is not a matter of immediate political short-sightedness. It is a matter of a long-time trend of national economic philosophy, which has been manifested in the same way, consistently, by succeeding national administrations embracing at least three different political parties."

Major General Ashburn Out

One unlooked for, but not unwelcome reaction of the application of the Reorganization Act of 1939 has been the elimination of Major General T. Q. Ashburn as president and chairman of the government-owned Inland Waterways Corporation. Formerly under the War Department, that corporation was on July 1 transferred to the Department of Commerce. The General and the Assistant Secretary of Commerce J. Monroe Johnson, to whom he was assigned to report, did not get along very well together. The General went over Johnson's head to the White House and seemed to find sympathy there, although it now appears that he did not tell the President all of the story. When Attorney-General Murphy finally got into the situation, things started to happen. Ashburn is now out and an expensive yacht which he used has been disposed of. During the controversy Assistant Secretary Johnson is reported to have said, "The corporation is to be run just like Congress said it would —just like a privately owned corporation— to see if water transportation can be profitable."

Master Showman

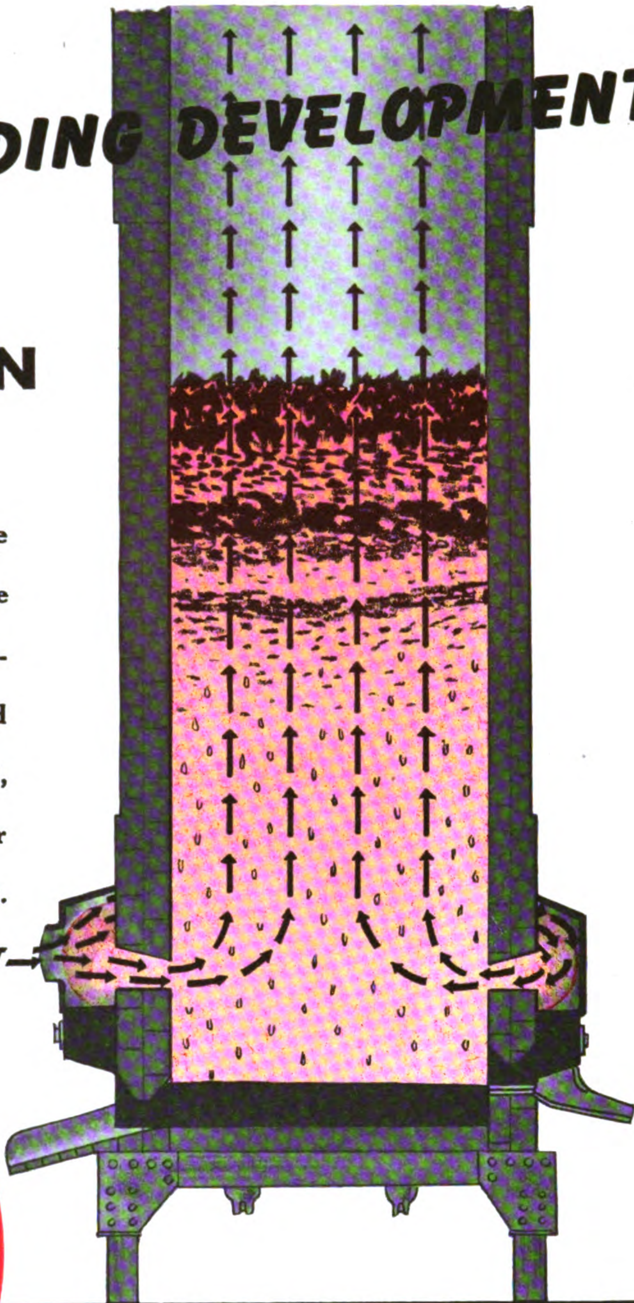
Edward Hungerford, the author who has done so much to popularize the railroads by his writings, is noted also because of his dramatic instinct. To his genius in this respect is largely attributed the success of the Fair of the Iron Horse, which was held in Halethorpe, Md., for a period of three weeks and a day in the fall of 1927, in connection with the observance of the Baltimore & Ohio's centenary. A million and a quarter people saw this pageant. Without question, the most popular single feature at the Century of Progress Exposition in Chicago during 1933 and 1934 was the transportation pageant, Wings of a Century, which was put on under Mr. Hungerford's direction. Again, in 1936, Mr. Hungerford scored a hit with The Parade of the Years, another transportation pageant, at the Great Lakes Exposition at Cleveland, Ohio. It was not to be wondered at that he was called upon by the Eastern Railroad Presidents' Conference to stage Railroads on Parade at the New York World's Fair this summer. More elaborate than the preceding pageants, and this time designated as an "opera-pageant", it drew total paid admissions of 1,281,349. Its cast included 200 actors and 671 performances were given. The show required a staff of 348 persons, 50 horses, four oxen, four mules and 20 locomotives under steam. Like the preceding pageants, it did much to create good will for the railroad industry.

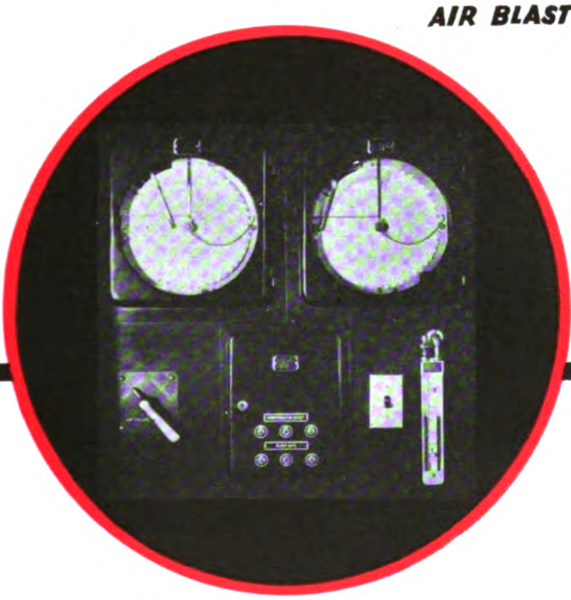
(*Turn to next left-hand page*)

ANOTHER OUTSTANDING DEVELOPMENT

UNIFORM CUPOLA OPERATION NOW ASSURED

Automatic cupola control, made possible for the first time by the Carbon Dioxide Compensator designed by our Research Department, has resulted in the production of more uniform metal and, therefore, provides one more valuable aid to our aim of making every wheel as good as the best.





Carbon Dioxide Compensator for automatically regulating cupola operation. This control device received first prize in an instrumentation contest in which there were 70 entries from the United States and foreign countries.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE,
NEW YORK, N. Y.

445 N. SACRAMENTO BLVD.,
CHICAGO, ILL.

AMCCW

ORGANIZED TO ACHIEVE:
- Uniform Specifications
- Uniform Inspection
- Uniform Product

NEWS

Equipment Depreciation Orders

EQUIPMENT depreciation rates for six railroads, including the Fort Worth & Denver City and the Bangor & Aroostook, have been prescribed by the Interstate Commerce Commission in a new series of sub-orders and modifications of previous sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies. The composite percentages, which are not prescribed rates, range from 2.99 per cent for the Bangor & Aroostook to 11.17 per cent for the Gulf & Northern.

The Fort Worth & Denver's City composite percentage of 3.57 is derived from prescribed rates as follows: Steam locomotives, 3.13 per cent; freight-train cars, 4.01 per cent; second-hand gas-electric rail motor cars, 7.58 per cent; stainless steel passenger-train cars, 3.9 per cent; "second-hand Diesel-electric zephyr type streamline train owned by the Burlington-Rock Island Railroad Company," 7.79 per cent; "Diesel-electric streamline train owned by the Chicago, Burlington & Quincy," 6.1 per cent; all other passenger-train cars, 2.93 per cent; work equipment, 4.13 per cent; miscellaneous equipment, 15.27 per cent.

The above-mentioned Bangor & Aroostook composite percentage of 2.99 is derived from prescribed rates as follows: Steam locomotives, 2.86 per cent; all-steel freight-train cars, 2.75 per cent; all other freight-train cars, 3.25 per cent; passenger-train cars, 2.39 per cent; work equipment, 3.38 per cent; miscellaneous equipment, 20 per cent.

S. A. L. Exhibit Locomotive

AT a cost of more than $2,000 and five days of hard work, the 560,000-lb., two-unit Diesel-electric locomotive built by the Electro-Motive Corporation and exhibited at the entrance of the General Motors building at the New York World's Fair since its opening, has been moved to the Electro-Motive plant at La Grange, Ill., for a full servicing before it is turned over to its owner, the Seaboard Air Line. Trees, hot dog stands, lamp posts and other obstacles had to be torn down to make possible the removal of the huge machine from the building to the tracks of the Long Island. The locomotive was moved under its own power on sections of track which were picked up and laid down on a circuitous route out of the Fair grounds. Once on the Long Island tracks the locomotive was driven to the East River, lightered to Jersey City and sent over the Baltimore & Ohio tracks to La Grange.

Equipment Purchasing and Modernization Programs

Bessemer & Lake Erie.—This company has asked the Interstate Commerce Commission for authority to assume liability for $5,700,000 of 2½ per cent equipment trust certificates, maturing in 10 equal annual installments of $570,000 on December 1, in each of the years from 1940 to 1949, inclusive. The proceeds will be used as part payment for equipment costing a total of $7,600,000, and consisting of 1,000 90-ton steel hopper cars, 500 50-ton steel gondola cars, and 500 50-ton steel box cars, orders for which were announced in the November issue.

Elgin, Joliet & Eastern.—The E. J. & E. has asked the Interstate Commerce Commission for authority to assume liability for $4,250,000 of 2½ per cent serial equipment trust certificates, maturing in 10 equal annual installments of $425,000 on December 1 in each of the years from 1940 to 1949, inclusive. The proceeds will be used as part payment for equipment costing a total of $6,000,000, and consisting of eight 600 h.p. Diesel-electric locomotives, 500 50-ton steel gondola cars and 1,500 50-ton steel hopper cars, some of which equipment has already been ordered.

New York Central.—The New York Central has placed orders for five Diesel-electric switching locomotives of 600 h.p. each, with the Electro-Motive Corporation. This road's recent purchases of rail, cars (reported in the October *Railway Mechanical Engineer*) and locomotives amounts to $14,700,000 and material was also purchased at an additional cost of $2,500,000 for use in repairing cars and locomotives in its own shops, which work has been underway since last July.

Northern Pacific.—The Northern Pacific has asked the Interstate Commerce Commission to approve a plan whereby the Reconstruction Finance Corporation would purchase $5,000,000 of 2¾ per cent serial equipment trust certificates, maturing in 20 semi-annual installments of $250,000 beginning August 1, 1940, and ending August 1, 1949. The proceeeds would be used in part payment of the purchase price of equipment costing $5,560,000, which would consist of the 1,000 steel-sheathed box cars, the 500 gondola cars, the 400 all-steel hopper bottom gondola cars, and the 100 steel multiple-service cars, ordered as announced in the November issue.

The Pacific Fruit Express has approved a $10,000,000 program for the rebuilding of 2,500 refrigerator cars and the repair of a number of others during the first six months of 1940. The 1939 budget provided for the rebuilding of 2,300 cars, 500 of which remain to be completed before the end of the year. In addition, the company is building 25 super-giant cars at a cost of $150,000.

Seaboard Air Line.—The Seaboard has applied to the Interstate Commerce Commission for approval of a plan whereby the Reconstruction Finance Corporation would

Special tracks had to be laid to move the Seaboard Air Line Diesel-electric locomotive out from the General Motors exhibit after the closing of the New York World's Fair

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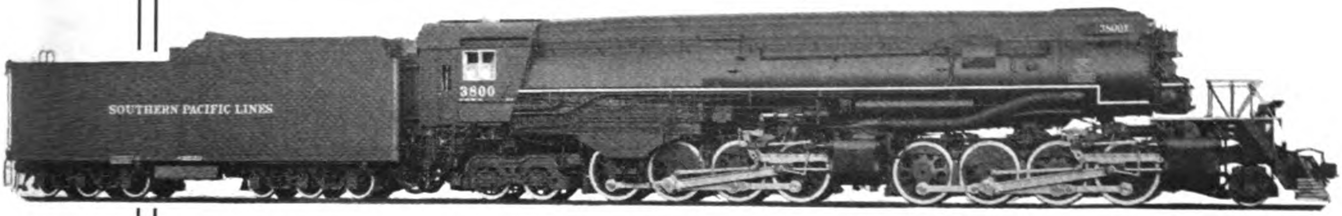
HIGH SPEED MALLETS
FOR THE
SOUTHERN PACIFIC



The first of twelve high-speed 2-8-8-4 type locomotives recently delivered by Lima to the Southern Pacific Company.

These locomotives will be used by the Southern Pacific Company to meet their requirements of high-capacity, high-speed freight and passenger service.

WEIGHTS IN WORKING ORDER, POUNDS				
On Drivers	Eng. Truck	Trailer Truck	Total Engine	Tender Loaded
Front Unit 265,500 Rear Unit 265,700	48,300	Front 48,900 Rear 61,500	689,900	400,700

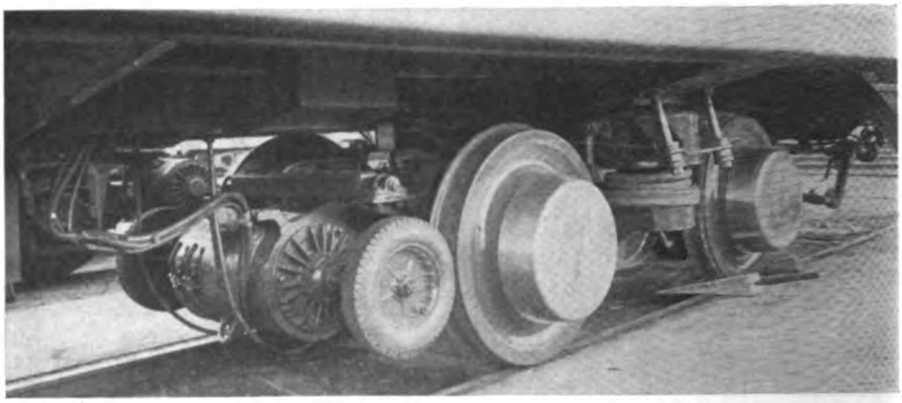
WHEEL BASE			TRACTIVE EFFORT
Driving	Engine	Eng. & Tender	Main Cylinders 124,300
44′-7″	66′-3″	112′-11 7/8″	

BOILER		CYLINDERS 4		DRIVING WHEEL
Diameter	Pressure	Diameter	Stroke	Diameter
97 1/16″ Front 109 1/8″ Back	250 lbs.	24″	32″	63 1/2″

LIMA LOCOMOTIVE WORKS, INCORPORATED, LIMA, OHIO

aid in financing part of the purchase price of equipment costing $2,529,546. The plan contemplates the issuance of $2,250,000 of three per cent equipment trust certificates, Series II, which would mature in 15 equal annual installments beginning November 1, 1940. The equippment involved includes 700 50-ton all-steel box cars to be purchased from Pullman-Standard Car Manufacturing Company; 100 50-ton flat cars to be built by American Car & Foundry Company; and 100 70-ton all-steel hopper cars, ordered from Bethlehem Steel Company, the orders for which were announced in the November issue.

Texas & Pacific.—The T. & P. has asked the Interstate Commerce Commission for its approval of a plan whereby it would assume liability for and sell to the Reconstruction Finance Corporation $1,335,000 of three per cent equipment trust certificates, maturing in 15 equal annual instalments of $89,000. The proceeds will be used in part to finance the purchase of 500 50-ton steel box cars, costing $1,420,610. The order for this equipment was announced in the November issue.



One of the Milwaukee's new passenger car trucks, which embody inboard roller bearings and a rotor brake, and weighs only 25,000 lb. per car

Newly-Designed Passenger Car Truck Tested on Milwaukee

A NEW passenger-car truck designed by the mechanical department of the Chicago, Milwaukee, St. Paul & Pacific and embodying a number of departures from conventional design, was recently tested by this road. The new four-wheel truck has inboard roller bearings, rotor brakes and newly-perfected coil springs and snubbers. Other changes include an unusually short wheel base of 6 ft. and a pneumatic rubber-tired generator drive directly from the tread of the wheels. The new trucks weigh 25,000 lb. per car, which is 5,000 lb. lighter than the trucks now used on the Milwaukee's streamlined Hiawathas. The rotor brakes have a braking area of 576 sq. in., as compared with 92 sq. in. for conventional brake shoes, and it is said the rotor brake allows a smoother stop with less noise from the braking operation. The Milwaukee intends to install the new type of trucks on its Hiawatha equipment, if further tests prove satisfactory.

Railroads Develop Chemical to Prevent Corrosion

ANNUAL savings of two million dollars are expected to result from the development by the railroads of a chemical which will inhibit the corrosive effects on equipment, track and bridges, of brine that drips from refrigerator cars, according to the Association of American Railroads. Development of the chemical resulted from a series of tests conducted over a period of several years by this Association in co-operation with various railroads.

In an effort to put a stop to this damage, a series of laboratory tests was instituted in order to develop a chemical which when added with the salt to the ice in the bunkers would neutralize the corrosive effects of the brine. After extensive laboratory experiments, the A. A. R. statement says, a chemical has been found which "gives good promise of inhibiting corrosion without interfering with refrigeration." The laboratory tests were conducted under the general direction of W. I. Cantley, mechanical engineer, Mechanical Division, and G. M. Magee, research engineer, Engineering Division of the A. A. R.

New Equipment Orders and Inquiries Announced Since the Closing of the November Issue

LOCOMOTIVE ORDERS

Road	No. of Locos.	Type of Loco.	Builder
Central of Georgia	1	600-hp. Diesel-elec.	Electro-Motive Corp.
Chicago, Rock Island & Pacific	5	360-hp. Diesel-elec.	Davenport-Besler Corp.
	5	360-hp. Diesel-elec.	Whitcomb Loco. Co.
Erie	3	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	4	600-hp. Diesel-elec.	American Loco. Co.
Newburgh & South Shore	1	1,000-hp. Diesel-elec.	American Loco. Co.
New York Central	5	600-hp. Diesel-elec.	Electro-Motive Corp.
Panama Railroad, Canal Zone	5	Diesel-elec.	General Elec. Co.
Roberval & Saguenay	1	2-8-0	Canadian Loco. Co., Ltd.
Tennessee Central	1	660-hp. Diesel-elec.	American Locomotive Co.

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Argentine State Railways	200	Tank	Pullman-Std. Export Corp.
D. L. & W.	500	50-ton hopper	American Car & Foundry Co.
	100	70-ton gondolas	American Car & Foundry Co.
	500	50-ton box	Magor Car Corp.
Elgin, Joliet & Eastern	500	50-ton gondola	Mt. Vernon Car Mfg. Co.
	300	50-ton hopper	Ralston Steel Car Co.
	300	50-ton hopper	Pullman-Std. Car Mfg. Co.
	300	50-ton hopper	Gen. American Trans. Co.
International Railways of Central America	5	Tank	Magor Car Corp.
Newburgh & South Shore	100	50-ton gondola	Magor Car Corp.
Philadelphia Quartz Co.	10	Tank	American Car & Foundry Co.
Phillips Petroleum Co.	1	Tank	Gen. American Trans. Co.
	10	Tank	American Car & Foundry Co.
Pittsburgh & West Virginia	5	Caboose	Company shops
Utah Copper Co.	100	Ore	Pressed Steel Car Co.
U. S. Navy Dept., Bureau of Supplies and Accounts	1	50-ton flat	....
	1	50-ton box	....

FREIGHT-CAR INQUIRIES

Road	No. of Cars	Type of Car	Builder
Lake Terminal	100-200	70-ton gondola	....

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Companhia dos Caminhos de Ferro Portugueses	28	St. steel pass.	Edw. G. Budd Mfg. Co.

The Steel Industry in Photographs

THE United States Steel Corporation has published recently a book of 111 photographs of unusual size and clarity which comprise a pictorial presentation of the steel industry. Action "shots" show not only the various stages in the manufacture of steel and steel products, but as well the extraction and transportation of raw materials,—iron ore, coal and limestone. Most impressive of the scenes are those of Bessemer converters, tapping a blast furnace and pouring molten iron into an open hearth furnace.

Of particular interest to railroad men will be views of an ore-carrying road between the Missabe Iron Range and the shores of Lake Superior and an eight-page section of the book dealing with steel for railroads which contains photographs giving complete views of the manufacture of rails, axles and wheels.

A. A. R. Research Plans Being Continued

A PROGRAM, continuing for the coming year a wide range of research activities designed to result in further improvements in railroad locomotive, car and track construction and in methods of operation, was

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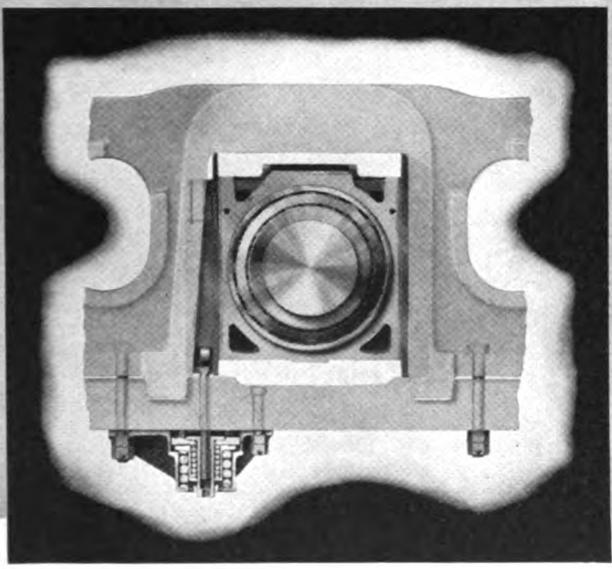
AIR GAP

means higher maintenance

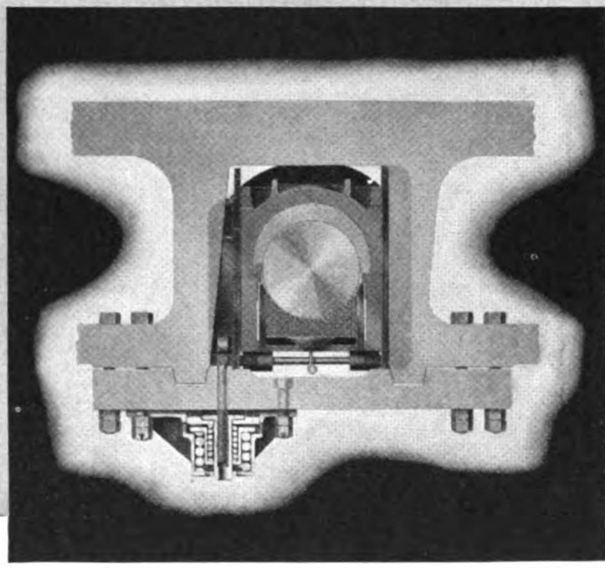
ELIMINATE IT WITH

FRANKLIN

AUTOMATIC COMPENSATORS AND SNUBBERS



Franklin Automatic Compensator and Snubber for Roller Bearing Driving Box application.



Franklin Automatic Compensator and Snubber for Friction Bearing Driving Box application.

With the hand-adjusted driving box wedge allowance must be made for temperature changes. This means that, until such time as the box expands to running speed temperature, the driving box pounds, and pounding driving boxes cost money. » » » There is no air gap on a locomotive equipped with Franklin Automatic Compensators and Snubbers. A constant, accurate fit is maintained and expansion and contraction due to changes in driving box temperature are taken care of *automatically.* These close tolerances are essential on roller bearing driving box applications. » » » Reduce maintenance . . . protect your driving boxes with Franklin Automatic Compensators and Snubbers, and eliminate slack between engine and tender with its twin, the E-2 Radial Buffer.

The close tolerances essential to efficient Booster operation call for genuine repair parts made by Franklin.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

adopted by the Association of American Railroads at its annual fall meeting in Chicago on November 10. Out of this work are expected to come still more powerful, speedier locomotives built without increased weight, lighter weight cars without diminished capacity or strength, better tracks and bridges and other improvements designed to expedite further the movement of freight and passenger traffic with increased safety and promote savings in operating costs.

One of the most important phases of this research work will deal with proposed improvements in steam locomotive construction in order to increase the speed and power without a proportionate increase in weight or in the use of fuel. Among the matters to be considered will be the development of specifications for a steam locomotive designed to haul a train of approximately sixteen standard passenger cars at a sustained speed of 100 miles an hour. Some road tests in respect to this have already been conducted. This study is being made under the direction of the mechanical engineer of the mechanical division by a special committee composed of railroad representatives and locomotive builders.

At the same time, engineers will endeavor to improve further the design and service of locomotives and increase the standardization of fundamental parts. Another series of tests will deal with refining the counterbalancing of the driving wheels of locomotives with the weight of the driving rods connecting the wheels with the cylinders in order to better meet present-day operating conditions which require higher speed and in order to reduce track maintenance costs.

The program also proposes that the railroads, under the auspices of the Association of American Railroads, continue to study the question of reducing further, by the use of lighter weight metals and through welding instead of the use of rivets, the weight of freight cars of different types without lessening their capacity or strength. A series of road tests to determine what improvements should be made in freight-car trucks in order to make possible a still greater increase in freight train speeds has just been completed.

In addition to research work dealing with locomotives and cars, the program also includes plans for extensive study and experiments looking toward a further improvement in track construction, improvements in various electrical devices, signaling and other forms of communication; packing, handling and storing of freight; simplification of stocks; increased standardization of parts; reclamation of old material and the handling of scrap iron; further improvements in safety of employees and passengers; improvements in car oil; effect on track maintenance of water blown from locomotives; and improved methods of caring for sick and injured employees.

New directors chosen at the fall meeting of the association include E. W. Scheer, president of the Reading, who takes the place of D. J. Kerr, president of the Lehigh Valley; G. D. Brooke, president of the Chesapeake & Ohio, who takes the place of C. E. Denney, now president of the Northern Pacific; L. W. Baldwin, chief executive officer of the Missouri Pacific, who takes the place of Ralph Budd, president of the Chicago, Burlington & Quincy; F. J. Gavin, president of the Great Northern, who takes the place of H. A. Scandrett, trustee of the Chicago, Milwaukee, St. Paul & Pacific; and A. D. McDonald, president of the Southern Pacific, who takes the place of Daniel Upthegrove, chief executive officer of the St. Louis Southwestern. All other officers were reelected.

Shop Improvements

The Cleveland, Cincinnati, Chicago & St. Louis is having an additional boiler installed at the enginehouse at Sharonville, Ohio, and stokers are being installed on the two old boilers at an estimated cost of $30,000.

The Chicago, Milwaukee, St. Paul & Pacific has awarded a contract to Lupinski, Inc., Milwaukee, Wis., for the construction of concrete foundations for extensions and improvements in the wheel foundry and other shop units at the car shops in West Milwaukee. The entire cost of the project, including new equipment to be installed, will be approximately $115,000.

The Chicago & North Western has awarded a contract amounting to approximately $40,000 to the Anderson Construction Company, Council Bluffs, Iowa, for the construction of a one-story 90-ft. by 100-ft. addition to the enginehouse at Council Bluffs, which will be used as a machine and maintenance shop.

Supply Trade Notes

JOSEPH H. KUHNS, vice-president in charge of Eastern railroad sales of the Union Asbestos & Rubber Company, Chicago, has been placed in charge of all railroad sales; William R. Gillies, vice-president in charge of Western railroad sales, has been placed in charge of production, engineering and research, with headquarters at Cicero, Ill.; Philip S. Nash, Western representative, with headquarters at San Francisco, Cal., has been elected assistant vice-president of railroad sales and service, with headquarters at Chicago, and has been succeeded by J. L. Adams; and W. H. Fehrs has been appointed assistant to the vice-president in charge of factory operations and management, with headquarters at Cicero, Ill.

William H. Gillies

Joseph H. Kuhns

Philip S. Nash

Joseph H. Kuhns entered railway service as a stenographer for the Illinois Central at Chicago, and for several years specialized in the sale of rubber products to railroads. In May, 1920, he was elected vice-president in charge of Eastern railroad sales for the Union Asbestos & Rubber Company, which position he has held until his recent promotion.

William R. Gillies entered railway service in 1914 in the mechanical department of the Oregon Short Line and in 1916 was appointed mechanical engineer. He resigned from that position in 1919 to be-

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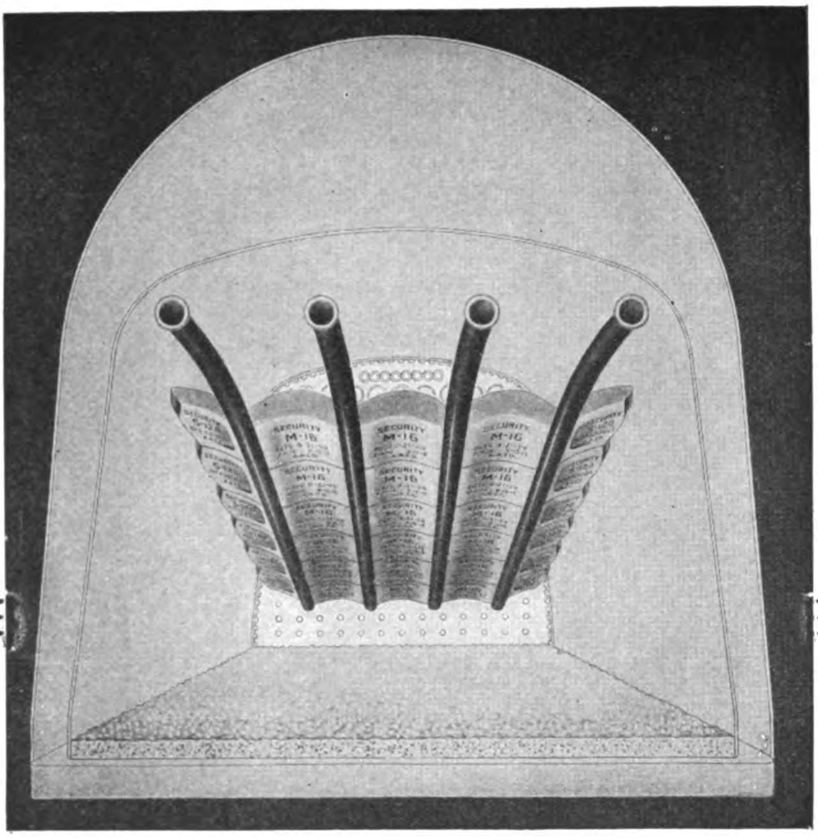


ANYTHING

less than a complete arch

IS FALSE ECONOMY

To let the desire for reduced inventory result in a locomotive leaving any roundhouse without a full set of Arch Brick is poor economy. » » » Even a single missing Arch Brick will soon waste many times its cost in fuel and in locomotive efficiency. » » » To spend the fuel dollar efficiently, every locomotive Arch must be maintained 100%. » » » Be sure your stocks on hand are ample to provide fully for all locomotive requirements, so that locomotive efficiency may be maintained.

There's More to SECURITY ARCHES Than Just Brick

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.

Locomotive Combustion Specialists

come assistant to the president of the Union Asbestos & Rubber Company, with jurisdiction over the development of products and sales. In 1922, he was elected vice-president in charge of Western railroad sales.

Philip S. Nash entered railway service with the Oregon Short Line in 1911 and after holding various positions in the mechanical department, resigned in 1926 to become service engineer for the Union Asbestos & Rubber Company at Salt Lake City, Utah. He held this position until 1929, when he was transferred to San Francisco as Western representative.

◆

CHARLES E. WILSON, executive vice-president, has been elected president and Philip D. Reed, assistant to the president, has been elected chairman of the board of directors of the General Electric Company. They will take over their new responsibilities January 1, succeeding Gerard Swope and Owen D. Young, who will become honorary president and honorary chairman of the board, respectively. Mr. Swope and Mr. Young, whose retirement becomes effective January 1, have served since May 16, 1922, as president and chairman, respectively, of the General Electric Company.

Charles E. Wilson was born in New York City on November 18, 1886, and began work as an office boy in 1899 with Sprague Electric, a former constituent

C. E. Wilson

company of General Electric. Since then he has served in many capacities, including shipping clerk, factory accountant, production manager, and assistant superintendent of the factory in 1914. Shortly thereafter he was appointed sales manager and in 1918, following the transfer of the conduit business from Sprague to General Electric, Mr. Wilson became assistant general superintendent of the Maspeth, N. Y., and New Kensington, Pa., works. In 1923 he went to Bridgeport, Conn., as managing engineer in charge of the conduit and wire business, and two years later was appointed assistant manager of its Bridgeport works. In June, 1928, he was appointed assistant to the vice-president in charge of the merchandise department and in 1930 was appointed manager of the merchandise department in charge of engineering, manufacturing and sales. In December of the same year he was elected a vice-president of General Electric, and was one of the original members of the newly-formed appliance sales committee of the company. In 1935 he was assigned additional responsibilities. Mr. Wilson is chairman of the board of the General Electric Contracts Corporation; a director of the General Electric Company, the Monowatt Electric Corporation, Providence, R. I.; the Electric Vacuum Cleaner Company, Cleveland, Ohio, and of Houses, Inc.; the Edison General Electric Appliance Company, Inc., Chicago; the Trumbull Electric Manufacturing Company, Plainsville, Conn., and the General Electric Supply Corporation, N. Y.

Philip D. Reed was born at Milwaukee, Wis., on November 16, 1899. He received

P. D. Reed

his engineering degree from the University of Wisconsin in 1921 and his doctor of laws from the Fordham University in 1924. His first work began while he was still a law school student taking evening classes at Fordham and, in 1922, before his graduation, he became vice-president and patent counsel for the Van Heusen Products Company, New York. Previous to that he was patent solicitor for Pennie, Davis, Marvin & Edmonds of New York. He entered the General Electric Company's employ in 1926, as assistant to vice-president of the company's law department in New York. In 1928 he was transferred to the incandescent lamp department, and from July 1, 1934, until his appointment as as-

Owen D. Young

sistant to the president in December, 1937, he was general counsel for the lamp department. Mr. Reed is a director of the General Electric Company, the General Electric Contracts Corporation and of a number of other companies.

Owen D. Young, who was born on October 27, 1874, at Van Hornesville, N. Y., became chairman of the board of the General Electric Company in May, 1922, having previously been vice-president in charge of policy. Mr. Young, who is a lawyer by profession, is a director of many large companies, including General Motors and the National Broadcasting Company. He was chairman of the board of Radio Corporation of America until 1929. His work on the Reparations Commission in Paris in 1923, when he unofficially represented the United States along with Gen. Charles G. Dawes, resulted in the Dawes Plan, which he later, as agent general of Reparations, put into actual operation.

Gerard Swope, who was born in St. Louis, Mo., December 1, 1872, was a helper in the Chicago service shop of the General Electric Company in 1893, while still an undergraduate at Massachusetts Institute of Technology. He was graduated with an electrical engineering degree in 1895 and returned to Chicago to serve in the shops of the Western Electric Company. After working his way up from there to a directorship and vice-presidency of Western Electric and winning the Distinguished Service Medal for his service on the General Staff of the United States Army in

Gerard Swope

1918, Mr. Swope returned to the General Electric Company and in 1919 became the first president of the International General Electric Company. He was subsequently manager of the Western Electric office at St. Louis, Mo., and Chicago, respectively, and general sales manager at New York. Mr. Swope became a vice-president and a director in 1913, and in 1917 visited the Orient, organizing a Chinese Western Electric Company and promoting trade interests and telephone service in Japan. He was elected president of the General Electric Company in May, 1922, and chairman of the board of International General Electric Company in April, 1927.

G. I. WRIGHT has been appointed railroad representative, with office in the Commercial Trust building, Philadelphia, Pa., for the Lebanon Steel Foundry, Lebanon, Pa. Mr. Wright has previously served with the Southern Pacific, Illinois Central, and with the Reading and Central Railroad of New Jersey, as chief electrical en-

gineer. From 1936 to 1938, he was manager of the transportation department of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. He has also served as chairman of the Electrical Section of the American Railroad Association; also of the Transportation Committee of the American Institute of Electrical Engineers and of the Manufacturers Advisory Committee of American Transit Association. During the World War, he was an assistant engineer officer of the Cruiser, U. S. S. Montana, and is a lieutenant commander, United States Naval Reserve Force.

◆

WARDEN F. WILSON, Pittsburgh district manager of the American Steel Foundries, Pittsburgh, Pa., has resigned to become general manager of sales of the Lebanon Steel Foundry, Lebanon, Pa. Mr. Wilson

Warden F. Wilson

has been associated with the steel-casting industry since his graduation from the University of Illinois in 1925, when he joined the American Steel Foundries as a special apprentice at its Indiana Harbor, Ind., Works. In 1928, he was appointed night superintendent, and a year later became assistant to the works manager, holding this position until his promotion and transfer to Pittsburgh, as manager of the Pittsburgh Works.

◆

D. H. YOUNG, vice-president in charge of export sales of the American Manganese Steel Division of the American Brake Shoe & Foundry Co., has been appointed director of exports, with headquarters at New York.

◆

R. B. NICHOLS, sales manager of the Bantam Bearings Corporation, South Bend, Ind., a subsidiary of the Torrington Company, Torrington, Conn., has become also secretary.

◆

FREDERICK J. GRIFFITHS, for the past three years president of the Griffiths-Bowman Engineering Company, has been appointed executive vice-president in charge of the newly-created Alloy-Steel Division of the Copperweld Steel Company, Glassport, Pa. Mr. Griffiths served from 1913 to 1926 with the Central Steel Company in positions ranging from general superintendent to president and general manager. From 1926 to 1929, at which time Central merged with the Republic Steel Corporation, he was chairman of the board of the Central Alloy Steel Corporation and then to 1931 he was president of the Republic Research Corporation and a member of the board of the Republic Steel Corporation. Subsequently he served as president of the Timken Steel & Tube Co., and a member of the board of Timken Roller Bearing Company. For the past three years, he was president of the Griffiths-Bowman Engineering Company. He is a director in a number of other industrial companies.

◆

J. G. GRAHAM has been appointed manager of railway sales and C. H. Reymer has been appointed railway sales engineer for the Oliver Iron & Steel Corporation, Pittsburgh, Pa.

◆

THE WHITCOMB LOCOMOTIVE COMPANY of Rochelle, Ill., a subsidiary of the Baldwin Locomotive works, has appointed the following sales representatives: At 120 Broadway, New York, Edward M. Sansom, formerly with the Electric Storage Battery Company; at 1010 Pine street, St. Louis, Mo., B. L. Beck, formerly with the Fate-Root-Heath Company, and at 627 Railway Exchange building, John R. Heckman, formerly with the Midvale Company. These representatives will handle the complete line of Whitcomb internal combustion and electric powered locomotives in the construction, industrial, and railroad fields.

◆

HAROLD D. PAGE, of the engineering department of the Waugh Equipment Company, New York, has been elected vice-president of that company, in charge of engineering, with headquarters, as for-

Harold D. Page

merly, at New York. Mr. Page, after completing a technical high school course in Chicago in 1912, worked for a time for the Link Belt Company and studied engineering during evening courses at the Armour Institute of Technology. He entered the employ of the shops and equipment department of the Chicago City Railway Company in the same year, remaining in that department after the merger of the various street railways to become the Chicago Surface Lines. Mr. Page entered the service of the Waugh Equipment Company on January 1, 1925, and was transferred to New York in 1933.

Obituary

CHARLES PASCHE, president of the Davenport - Besler Corporation, Davenport, Iowa, died on November 15.

◆

KARL J. LAMCOOL, who served for about two years as a member of the sales force of Manning, Maxwell & Moore, Inc., New York, died on October 29 after a brief illness.

Personal Mention

General

FRANK E. MOORE has been appointed general mechanical inspector of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan.

JAMES J. THOMPSON, assistant road foreman of engines, Norfolk division, of the Norfolk & Western, has been transferred to Roanoke, Va., as assistant trainmaster, Radford division.

J. B. NEISH, general master mechanic on the Northern Pacific, at Seattle, Wash., has been promoted to mechanical superintendent at St. Paul, succeeding B. P. Johnson, retired.

B. P. JOHNSON, mechanical superintendent of the Northern Pacific at St. Paul, Minn., retired on November 1. Mr. Johnson was born at Mt. Holly, N. J., on October 1, 1869, and served a five-year apprenticeship as machinist in jobbing shops at Philadelphia, Pa., and Camden, N. J. He entered railway service with the Northern Pacific on December 20, 1888, as an enginehouse laborer at Glendive, Mont., and a year later became a locomotive fireman, serving in that capacity and as a locomotive engineer at Glendive until September 1, 1903, when he was promoted to road foreman of engines at the same point. On April 1, 1908, he became master mechanic at Glendive, and on January 15, 1916, was transferred to Seattle, Wash. Mr. Johnson was promoted to general master mechanic of the lines between Mandan, N. D., and Paradise, Mont., with headquarters at Livingston, Mont., on June 15, 1923, and on March 15, 1928, was appointed mechanical superintendent of the lines east of Paradise, Mont., with headquarters at St. Paul, Minn. In the latter part of 1930 his jurisdiction was extended to include the lines west of Paradise.

W. J. BROWNE, electrical and mechanical engineer of the Salt Lake & Utah, at Salt Lake City, Utah, has been appointed also superintendent of maintenance, power and equipment of the Utah Idaho Central, with headquarters at Ogden, Utah.

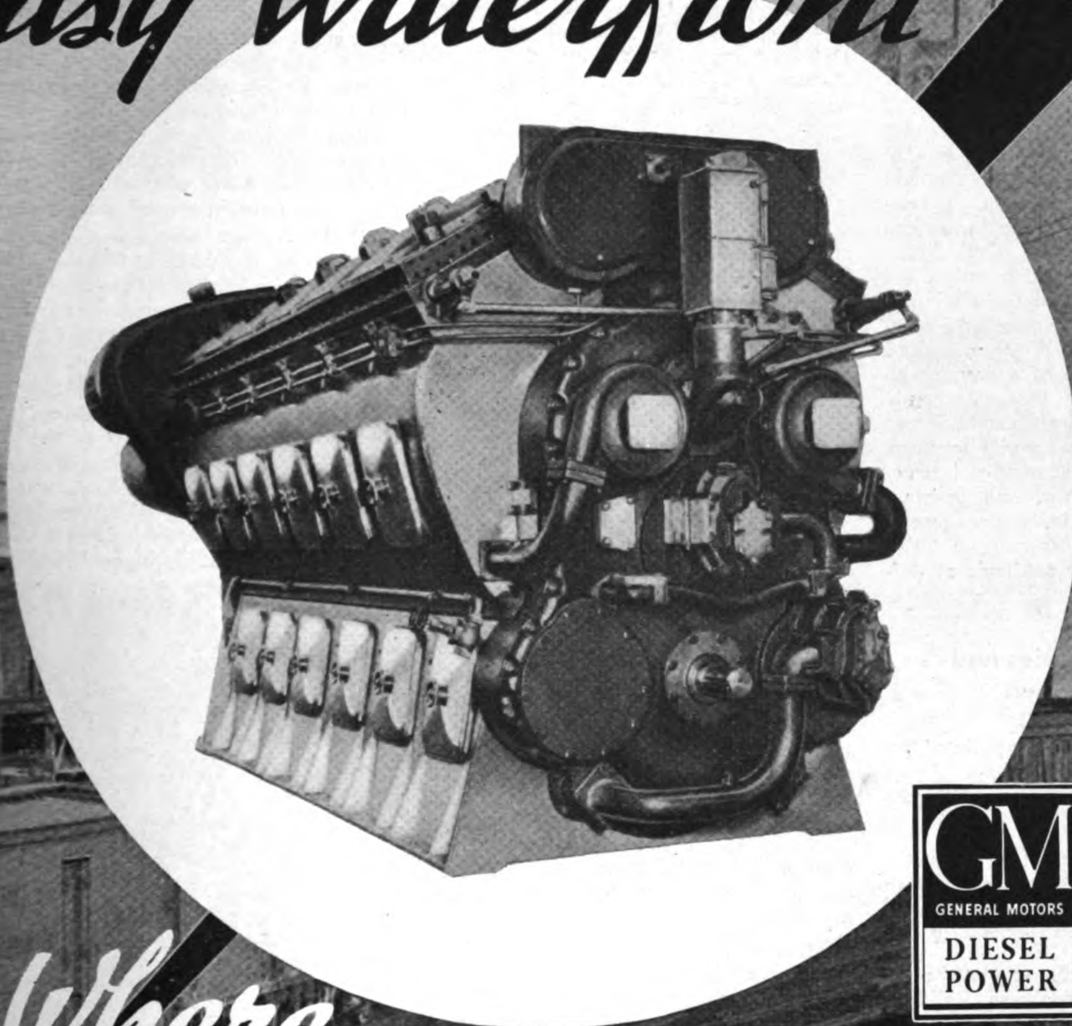
(*Turn to second left-hand page*)

EMC DIESELS *at a*

ELECTRO-MOTIVE

SUBSIDIARY OF GENERAL MOTORS

Busy Waterfront



GM
GENERAL MOTORS
DIESEL POWER

Where EVERY MOVEMENT MUST "CLICK"

THROUGH its Jersey City terminal the Erie Railroad handles a goodly portion of New York City's food supply. Daily hundreds of cars must be moved on floats and ferried across the Hudson like clock-work in order to avoid the heavy river and rail traffic during commuter rush hours. This calls for high terminal efficiency where car movements must "click".

EMC 1000 Hp. Switchers have been assigned to terminal operation at this important waterfront. Unobscured visibility, the characteristic of all EMC "Clear-View" type Switchers, and the complete absence of smoke and steam speed up yard movements and add materially to faster and safer operation at all times.

Performance records of over 300 EMC Diesel Switchers covering two million service hours prove an availability average of 95 per cent. In addition to maintaining this high serviceability, EMC Switchers are reducing locomotive costs from 50 to 75 per cent and frequently save $1,000.00 per month above carrying and amortization charges.

CORPORATION

LA GRANGE, ILLINOIS, U. S. A.

O. K. WOODS, fuel engineer of the eastern district of the Union Pacific, with headquarters at Omaha, Neb., has been appointed special representative of the vice-president in charge of operation, with the same headquarters. This newly-created position will include the duties of fuel engineer and road foreman of engines.

JOSEPH H. BECKER, who has been appointed assistant to superintendent of motive power of the Chicago Great Western, with headquarters at Oelwein, as announced in the November issue, was born on December 5, 1888, at St. Paul, Minn. He attended the Oelwein public school and took a course in mechanical engineering at Iowa State College. He entered the service of the Chicago Great Western in June, 1906, becoming a machinist apprentice on August 1 of that year. He subsequently served as a machinist, draftsman, assistant machine shop foreman, gas engine foreman, efficiency engineer and apprentice instructor, production supervisor, and assistant mechanical engineer. He became general locomotive and boiler inspector on October 10, 1936, and master mechanic at Oelwein on May 1, 1938.

Master Mechanics and Road Foremen

W. R. JACKSON has been appointed assistant road foreman of engines, of the Radford division of the Norfolk & Western.

ALEXANDER PEERS, master mechanic, Quebec district, Canadian Pacific, with headquarters at Montreal, Que., has retired under the company's pension rules.

A. N. GOSNELL has been appointed master mechanic of the Oklahoma Railway, with headquarters at Oklahoma City., Okla., succeeding W. E. Voss.

W. D. NELSON, general foreman of the Louisville & Nashville at Montgomery, Ala., has been appointed assistant master mechanic, South Louisville (Ky.) shops.

ASHBURN OLIVER, assistant road foreman of engines of the Radford division of the Norfolk & Western, has been appointed assistant road foreman of engines, Norfolk division, with headquarters at Crewe, Va.

R. V. CARLETON, division master mechanic, Ontario district, Canadian Pacific, at Toronto, Ont., has been appointed master mechanic of the Quebec district, with headquarters at Montreal, Que.

Shop and Enginehouse

I. H. DOYLE, assistant enginehouse foreman of the Norfolk & Western at Shaffers Crossing, Roanoke, Va., has been promoted to the position of night enginehouse foreman at Roanoke.

F. W. SCHULTZ, shop superintendent on the Atchison, Topeka & Santa Fe at West Wichita, Kan., has retired, and the position of shop superintendent at Wichita has been abolished.

Purchasing and Stores

CLARE R. HOLMES has been appointed general storekeeper of the Atchison, Topeka & Santa Fe system, with headquarters at Topeka, Kan. Mr. Holmes was born in DeKalb County, Ill., and attended Oberlin College. Following a short period of service in the freight department of the Chicago, Burlington & Quincy at Chicago, he entered the service of the Santa Fe on January 2, 1910, in the stores department at San Bernardino, Cal. He served in various capacities until early in 1917, when he became division storekeeper at Richmond, Cal. In 1919 he returned to San Bernardino as chief clerk to the district storekeeper, and on January 1, 1938, was promoted to district storekeeper of the Coast lines, with headquarters at San Bernardino, the position he held until his recent promotion.

Clare R. Holmes

EVERETT B. LEBO has been appointed purchasing agent of the Fort Dodge, Des Moines & Southern, with headquarters at Boone, Iowa, succeeding J. E. Wenzel, who has retired.

HARRY J. BLUM, assistant general storekeeper of the Missouri-Kansas-Texas, at Parsons, Kan., has been appointed general storekeeper, with headquarters at Parsons. Mr. Blum was born at Galesburg, Ill., and attended high school and Business Institute. He entered railway service in 1899 on the Chicago, Burlington & Quincy at Galesburg and was transferred as a clerk to West Burlington, Ia., in 1905. In 1906 he became chief clerk to the storekeeper at Hannibal, Mo., and in 1907 left the Burlington to become a traveling accountant for the Missouri Pacific at St. Louis, Mo. Mr. Blum was promoted to district storekeeper at St. Louis in 1908, and in 1913 he became associated with the Terminal Railroad Association of St. Louis, serving in various capacities until 1915, when he joined the Katy as district storekeeper at Sedalia, Mo. In 1917, he was transferred to Parsons, Kan., and in 1937 was promoted to assistant general storekeeper.

Harry J. Blum

R. M. NELSON, purchasing agent of the Chesapeake & Ohio, at Cleveland, Ohio, has been appointed to fill the newly created position of general purchasing agent of the C. &. O., the New York, Chicago & St. Louis (Nickel Plate), and the Pere Marquette, with headquarters at Cleveland.

HORACE E. RAY, who retired on November 1 as general storekeeper of the Atchison, Topeka & Santa Fe system, with headquarters at Topeka, Kan., was born in Shepherdstown, W. Va., on May 18, 1871, and was graduated in 1890 from Wittenberg College at Springfield, Ohio. He entered railway service in August, 1890, at St. Joseph, Mo., with the St. Joseph Terminal Company, which was operated jointly by the Santa Fe and the St. Joseph & Grand Island (now part of the Union Pacific). In December, 1892, Mr. Ray entered the service of the Santa Fe in the stores department at Topeka, and in March, 1903, was promoted to assistant to the general storekeeper. Four months later he was advanced to storekeeper at Topeka and in June, 1909, became storekeeper of the Coast lines, with headquarters at San Bernardino, Cal. In September, 1914, he was appointed general storekeeper of the system, with headquarters at Topeka. In 1921-22 Mr. Ray served as chairman of the Purchases and Stores division of the Association of American Railroads. He has since served on the general and advisory committees and other subject committees.

Horace E. Ray

Obituary

E. V. FOX, night enginehouse foreman of the Norfolk & Western at Shaffers Crossing, Roanoke, Va., died in an automobile accident on October 10.

FRANK W. HOLT, purchasing agent of the Erie, with headquarters at Cleveland, Ohio, died in that city on November 11.

YOU CAN SAVE MONEY

FOR YOUR ROAD WASHING STREAMLINERS THE SAFE, LOW-COST OAKITE WAY

Is the removal of road dirt, oil film, soot and other deposits from your streamliners a troublesome, time-consuming job? Does it cost too much? Are painted surfaces being affected by cleaning materials you use?

Then why not profit by the experience of other roads . . . roads whose streamliners today are being washed with complete SAFETY to SURFACES with specially designed Oakite materials that clean quickly and with a minimum of manual effort. And not only are they enjoying the advantages of a satisfactory job but cost of doing the work on a material and time basis is attractively low.

Put Your Streamliner Washing Up To Us!

At your convenience and without any obligation on your part, we are ready to prove to you that the dependable Oakite materials recommended for washing streamliners are safe and economical. Arrange to make a test so that you can see with your own eyes the increased efficiency and improvements that are possible on this work. Write us today and let us submit complete data.

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OAKITE CLEANING CAN MAKE THESE JOBS EASIER FOR YOU

Stripping paint from locomotive tanks, coaches

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Removing rust or scale from Diesel engine water jackets

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Steam cleaning running gear

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Cleaning air compressors

—

Removing grease from driving box lubricators

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RAILWAY SERVICE DIVISION

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● Republic Double Strength Steels are low-cost, low-alloy steels—yet they stand high in the respect of designers and builders of railway equipment, for these reasons:

Because they permit new cost-saving methods of construction and are the easiest to fabricate of the high tensile steels.

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Because they stand hard use and abuse, and reduce maintenance costs.

Because the alloy content makes these materials more corrosion- and abrasion-resistant than ordinary steels, resulting in longer life of equipment.

Added together, these reasons make for more economical building and operation. May we send you technical literature?

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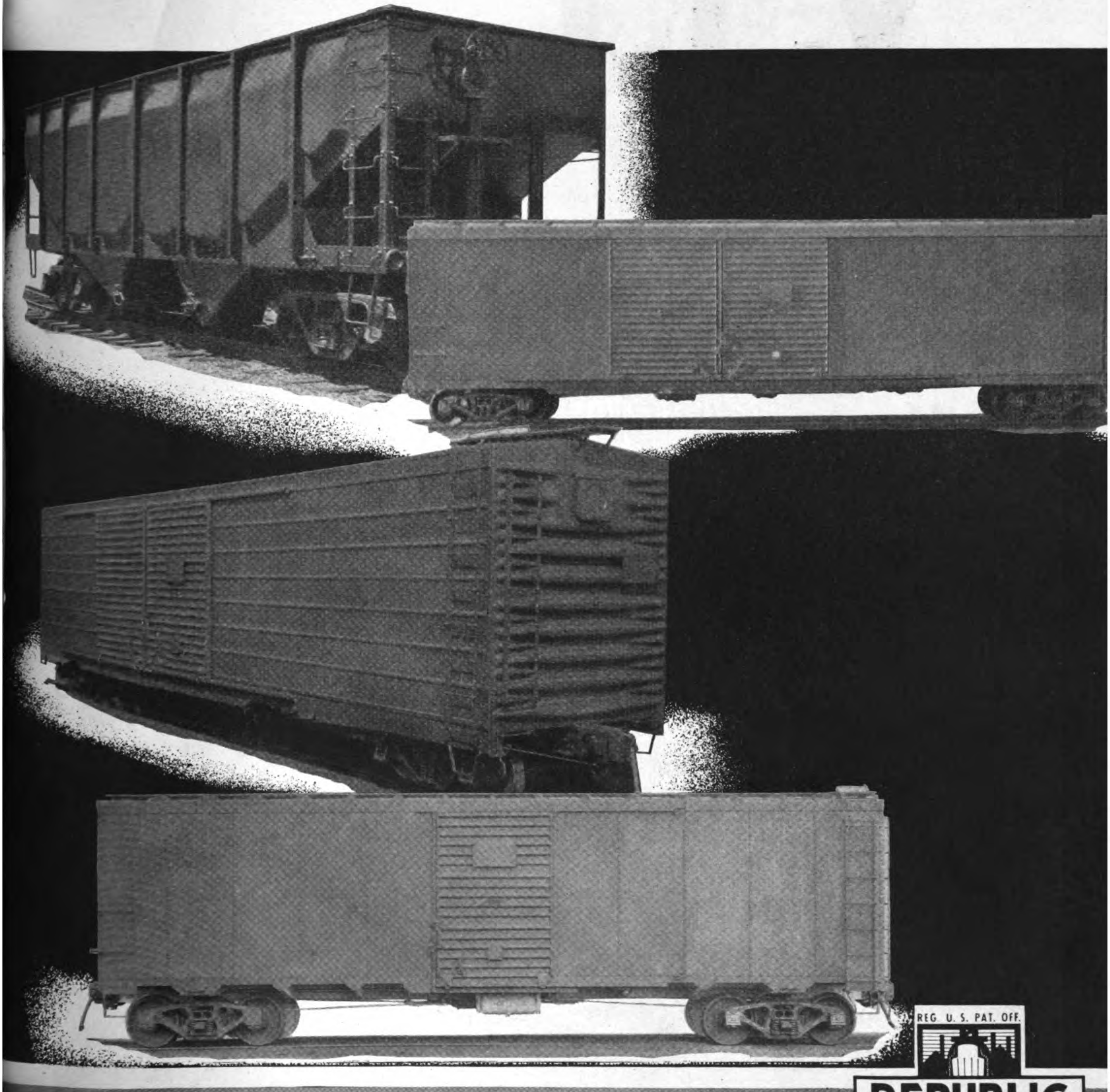
TRUSCON STEEL COMPANY • UNION DRAWN STEEL DIVISION

REPUBLIC
DOUBLE STRENGTH STEELS

LOOMS LARGE IN 1940



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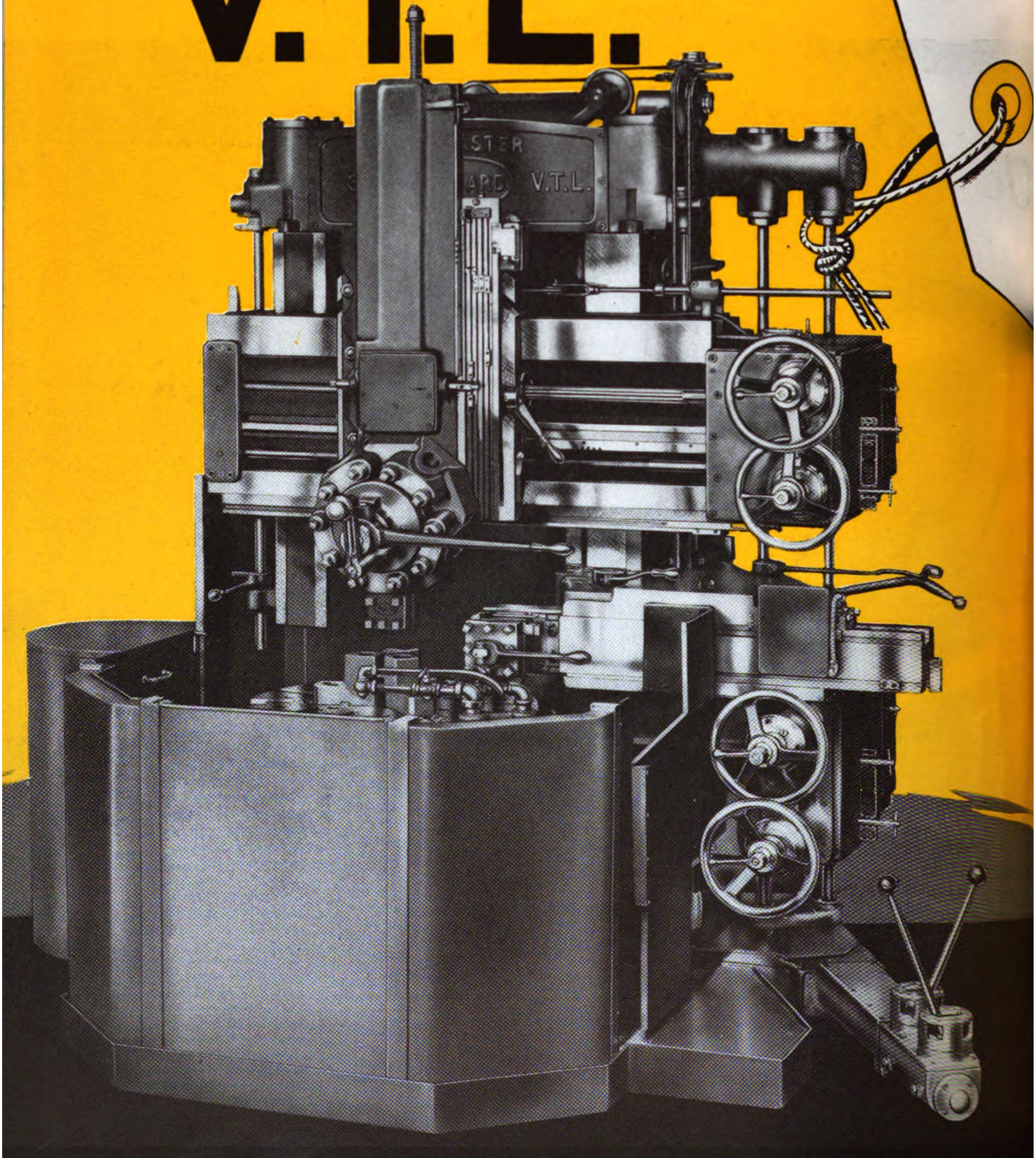
BULLARD CUT MASTER V.T.L.



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BULLARD CUT MASTER
for Railroad Work

APPROPRIATIONS for new units may be lean and a trifle hard to obtain but, this condition only serves to make the supervisors more alert to the possibilities offered by modern equipment.

To prove this and the fact that the railroads aren't behind the times where SAVINGS can be made: One of the first inquiries for the new CUT MASTER V. T. L. came from a leading railroad within a few days after the initial announcement. Specifications showed that this new BULLARD unit will meet every new anticipated production requirement.

The CUT MASTER V. T. L. is manufactured in five different sizes, i.e. 30″–36″–42″–54″ and 64″. The well balanced design permits the choice of six different head combinations—one of which is bound to suit your particular requirements. Be sure to keep this unit in mind when making out your next machine tool requisition.

BRIDGEPORT, CONNECTICUT

THE DEVELOPMENT OF THE BRAKE SHOE has been gradual and constant from its earliest days when wood and even, in some instances, stone were utilized.

As early as 1889, the first Brake Shoe Testing Machine was being used to help solve the braking needs of that day, and at the turn of the century, the all important Diamond-S method of reinforcement for car shoes was developed. Brake shoes of this construction were soon widely used for passenger car and tender service, and later were adopted by the Association of American Railroads as Standard for Interchange in freight, passenger car and tender service.

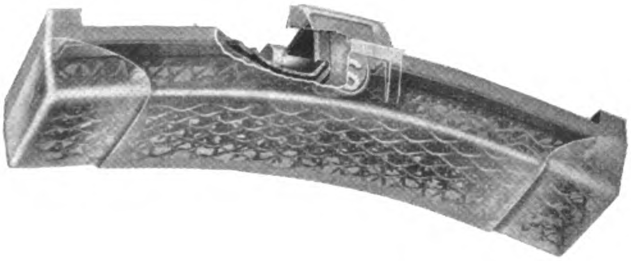
A later improvement—the Duplane reinforcement for freight car shoes—minimizes premature breakage and is already making substantial savings.

THE AMERICAN BRAKE SHOE

Driver shoes, too, passed through an evolution in which problems of construction, attachment and reinforcement were studied and solved. This culminated in the Samson Driver Shoe, which constitutes one of the most important improvements ever made in Brake Shoes.

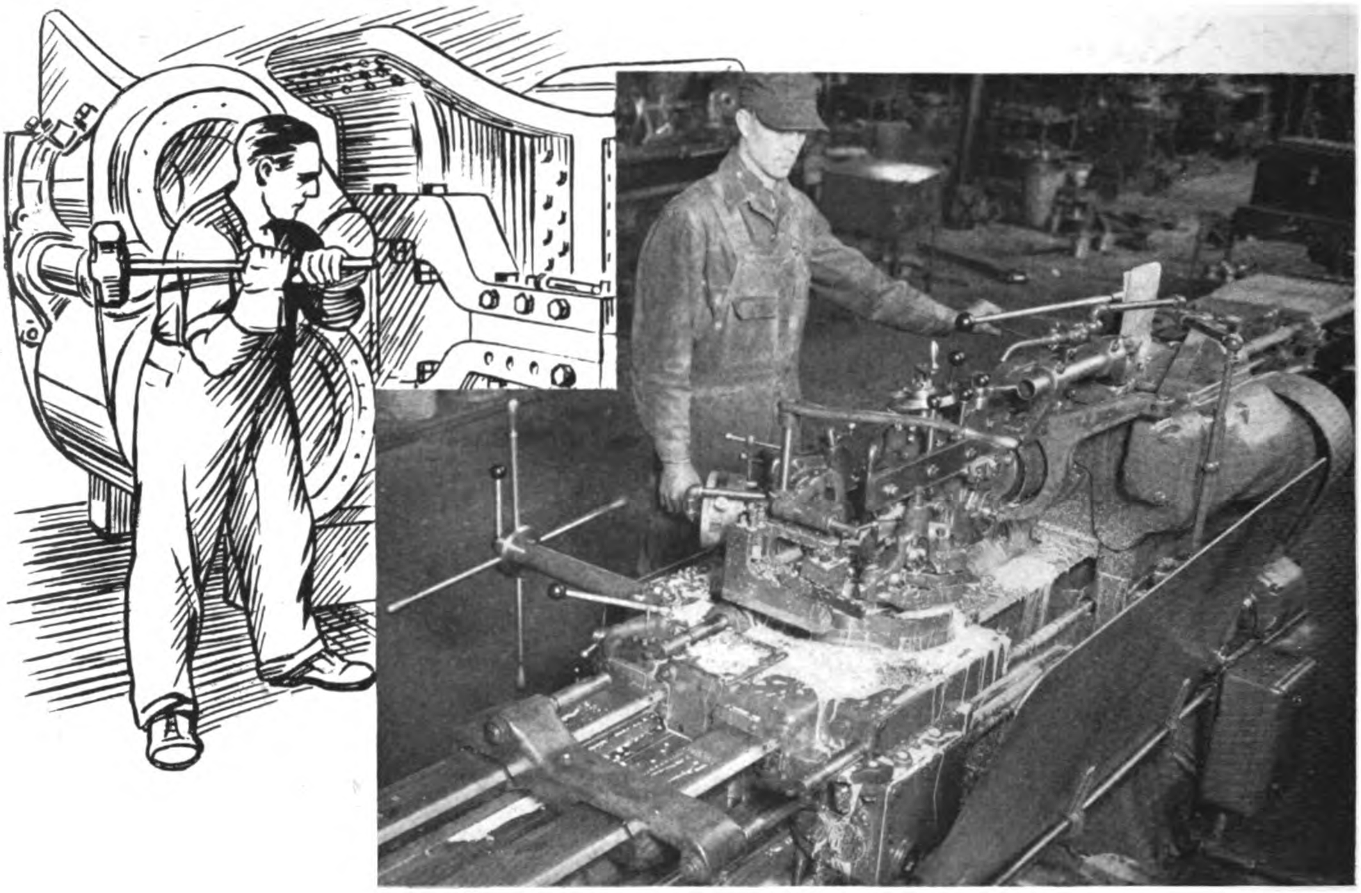
All of this development, while gradual, has been sure, and the braking problems of the day have been met as they arose.

Our new brake shoe testing machine, which is capable of duplicating speeds and axle loads well in excess of any conditions yet encountered in service, and our highly modernized chemical and metallurgical laboratories together with nearly half a century of experience give us the means to anticipate and solve the braking problems of the future. The design and construction of our brake shoes will continue to exceed past standards in the same degree to which the trains which use them will excel their predecessors.



AND FOUNDRY COMPANY

BRAKE SHOE AND CASTINGS DIVISION



20 to 60%

SAVINGS ON FRAME BOLTS

THIS statement refers to general average performance of new JONES & LAMSON Turret Lathes installed in many railroad shops.

Proof? Plenty of it. For example, the above illustrated unit not only displaced two old turret lathes on the frame bolt job, but also has played a big part in reducing general locomotive maintenance costs by providing new standards of taper precision.

Drive fits for bolts produced on this unit have been reduced to 1/8" and 3/16" and the men on the floor have a job socking 'em home. Naturally, the perfect taper fits prevent the working of frames and expensive consequences.

Production time for 1" tapered frame bolts 8½" long with a 2" thread is exactly three and one-half minutes per bolt.

Frame bolts are, of course, only one of the many railroad shop jobs which are machined for less cost on JONES & LAMSON Turret Lathes. It will pay you to investigate.

JONES & LAMSON MACHINE COMPANY
SPRINGFIELD, VERMONT

Manufacturers of Saddle and Ram Type Universal Turret Lathes, Fay Automatic Lathes, Double-End Milling and Centering Machines, Automatic Thread Grinding Machines, Comparators, Tangent and Radial, Stationary and Revolving Dies and Die Chasers.

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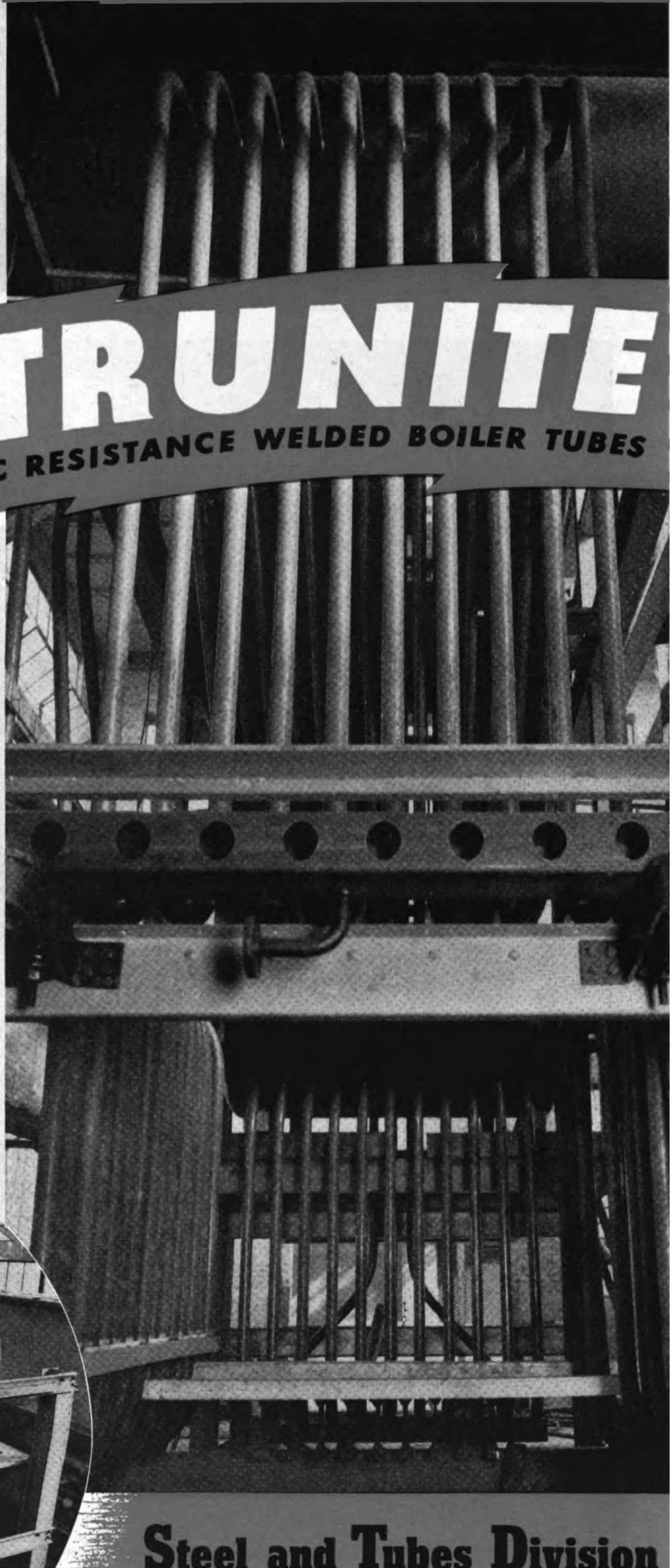
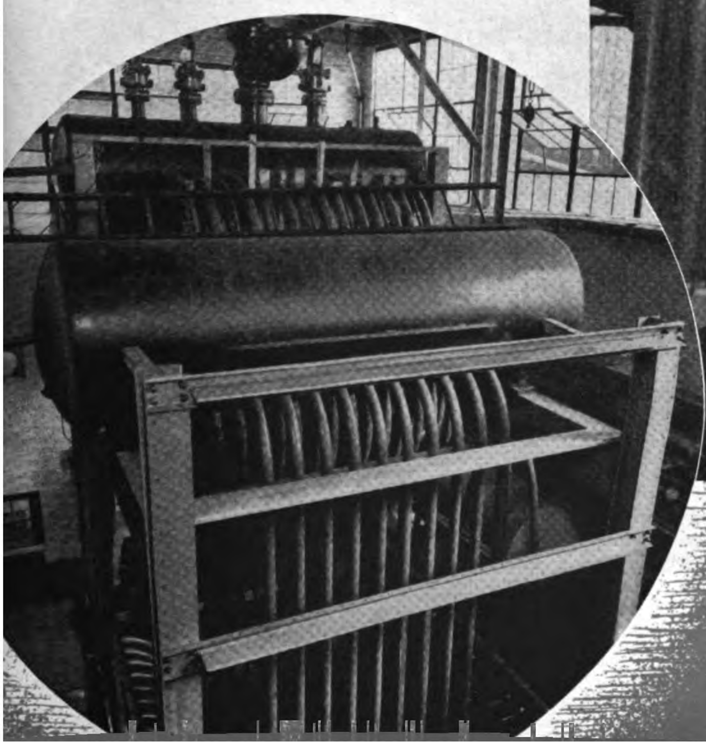
When the Henry Vogt Machine Company built this 200 lbs. pressure, 300 h. p., four-drum bent tube boiler for A. Finkl and Sons Company, Chicago, Ill., they used ELECTRUNITE Boiler Tubes.

Time after time, boiler manufacturers and users choose ELECTRUNITE for new boilers and for retubing old ones. They have found that ELECTRUNITE Tubes, through their consistent uniformity, ductility, scale-free surface and freedom from hidden defects, reduce installation costs and insure safety and long, trouble-free service life.

Avail yourself of the advantages of these modern tubes to improve YOUR heat transfer equipment. Write us for the full story on what ELECTRUNITE can do for you.





Steel and Tubes Division

REPUBLIC STEEL CORPORATION

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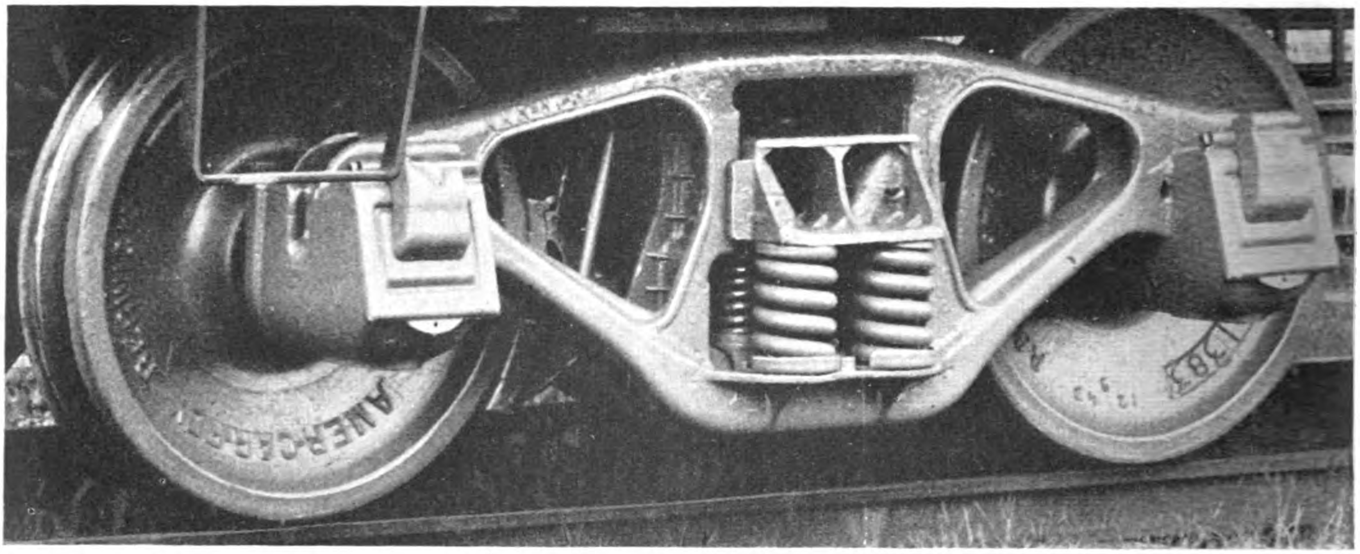

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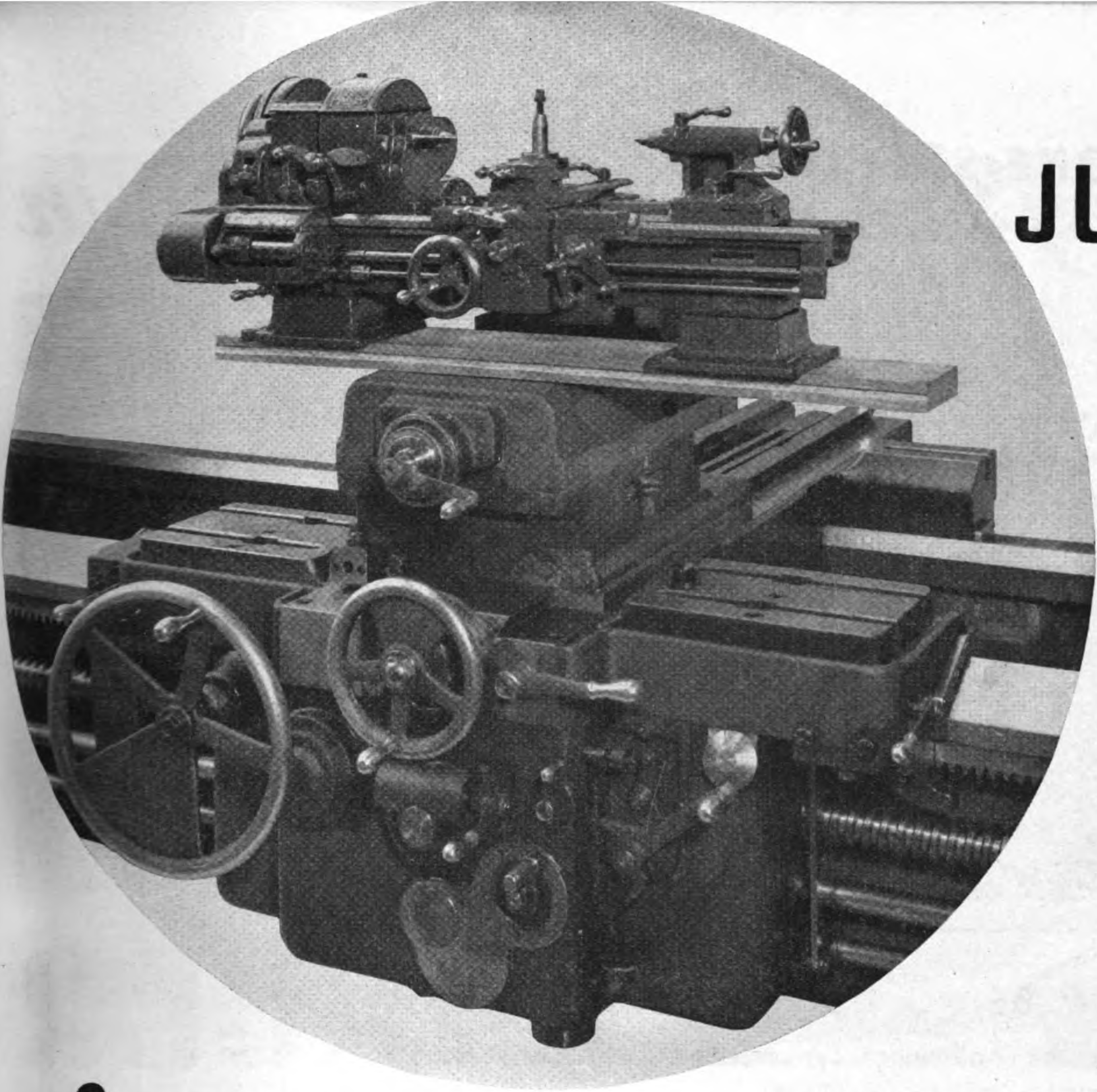

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SIZE is only relative. Take the LeBlond line of lathes, for example. The smallest LeBlond—the 10″ Regal bench lathe—although it measures 45 inches overall, and weighs 500 pounds—can ride on the carriage of the largest LeBlond—the 42″ heavy duty engine lathe.

You'll find in the LeBlond line a wide variety of swing sizes, one for every turning requirement. But you'll find only one standard for micrometer accuracy and cost-downing performance—the same high standard that has engineered and built the thousands of LeBlonds now in operation all over the world.

THE R. K. LEBLOND MACHINE TOOL CO.
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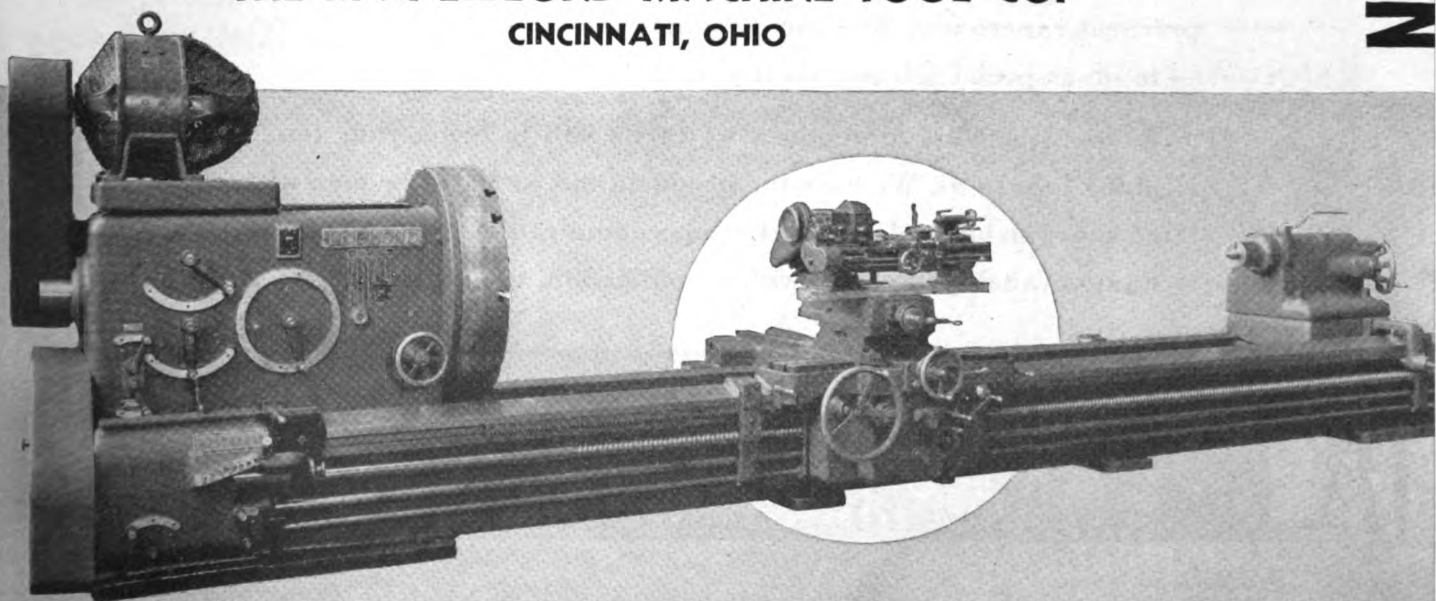
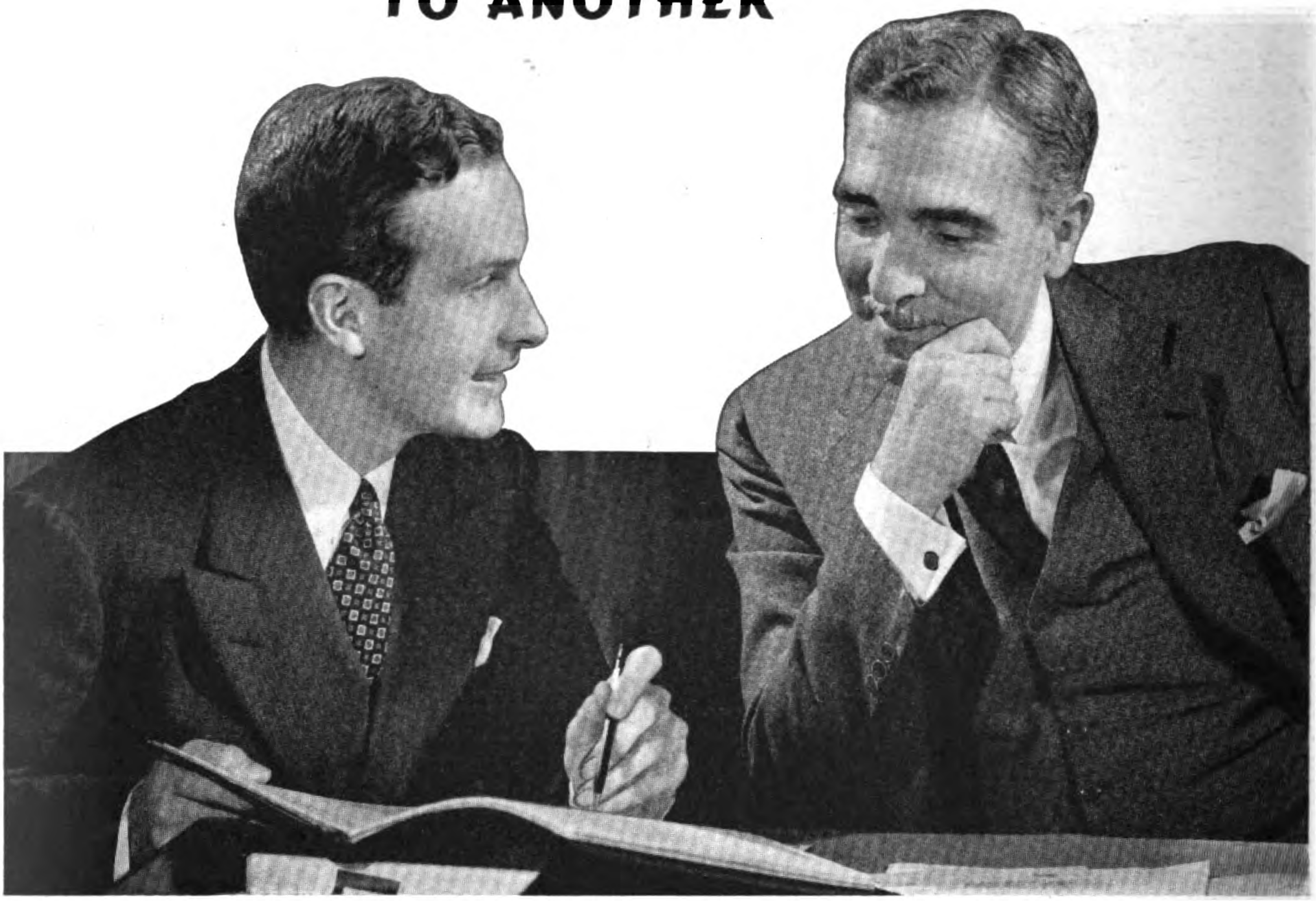


AS ONE SPECIALIST TO ANOTHER



YOU ARE a specialist in heavy machinery. You couldn't suddenly start to repair watches instead of railway equipment in your shop, any more than you could move a skilled lathe hand to the foundry and expect him to do expert work. You know *your job* and do it well.

Our job is cleaning. WYANDOTTE Technicians and Service Representatives have qualified as experts in metal cleaning through practical experience. And our products are designed the same way — to do a special job and do it well.

As one specialist to another, we invite you to bring your tough cleaning jobs to us. We have the products and we have the men who know they can be used efficiently and economically. Personal service is always available to you — without obligation, naturally.

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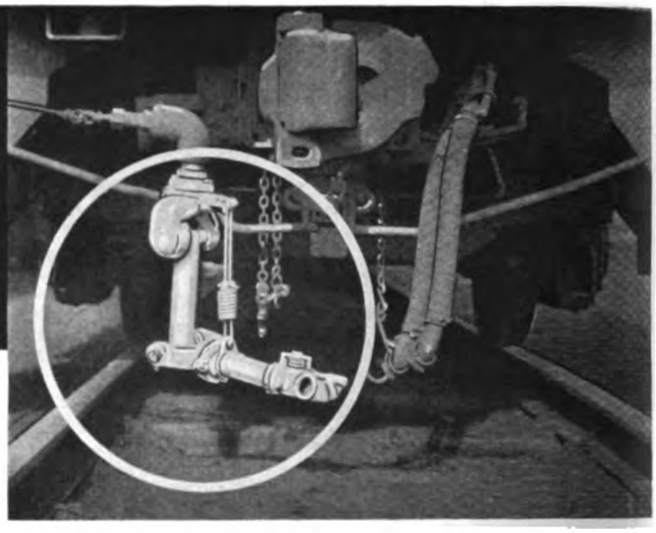

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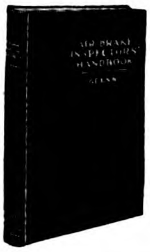

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Formerly Chief Safety Inspector on the C. M. St. P. & P. Railroad

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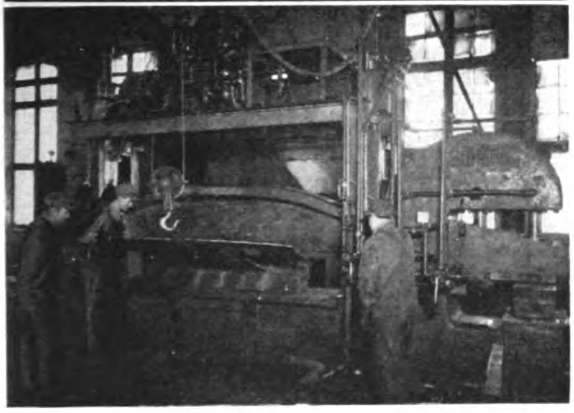
Watch Your Boiler Shop Costs Go Down After You Install a BEATTY



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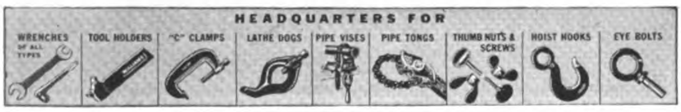

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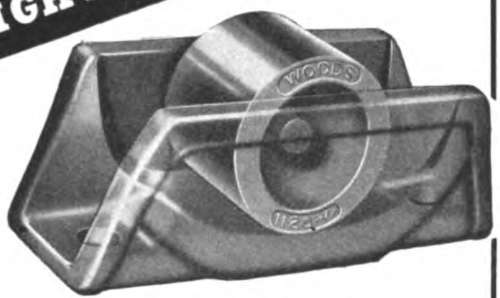

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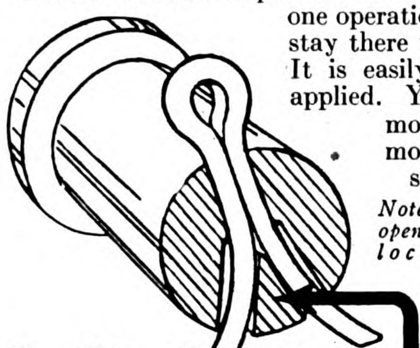
WHY take chances with ordinary cotters—especially since the speeds of all trains have been increased?

Every application on a car, locomotive or any other moving vehicle can be made in absolute safety with the COOKE Pin and Cotter.

A couple of taps with a hammer drives the COOKE Cotter into place. It is securely locked in one operation—and it will stay there until removed. It is easily and quickly applied. You save time, money and promote maximum safety.



Note: This wedge opens, spreads and locks the cotter, thereby eliminating vibration and wear.

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The new edition of this popular book on railroads describes latest practice. There are complete new chapters on streamlined trains and additions to others covering the new developments in air brakes, air conditioning of passenger cars and in high-speed Diesel and electric locomotives. Among the numerous new illustrations are shown the new streamlined trains, 7 in color. This is an excellent book for a boy who wants to know more about railroads and for the average reader.

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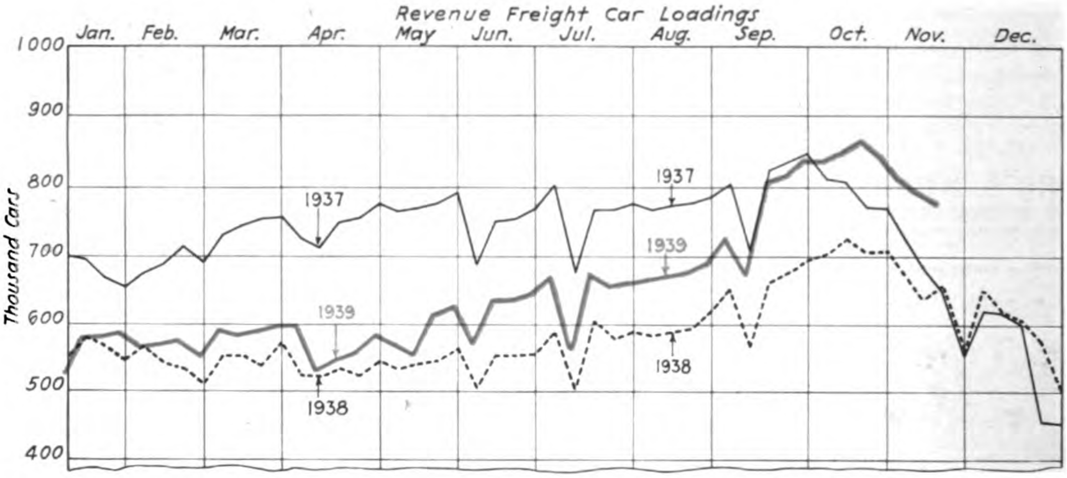
THE EDITOR'S DESK

LOADINGS INCREASE MAINTAINED— NET EARNINGS LARGEST SINCE 1930

Freight car loadings reached their peak this year in the week ending October 21, when they registered 861,198. This peak was reached one week later than in 1938, and three weeks later than in 1937.

These loadings have been reflected in net operating income, which in October totaled almost 102 million dollars—the highest in any month since October, 1930. For the week ending November 18 (the latest figures available when this was written) loadings were 17.4 per cent above the corresponding week in 1938, and 19.6 per cent greater than in 1937.



We can face the new year with considerable confidence. Business is good, both for consumer goods and in the heavy industries, and the prospects are that it will continue to remain so in this country for some time to come.

Members of Congress have been back home and have talked matters over with their constituents. The railroads have been enjoying a favorable attitude on the part of the general public and there seems little reason to question that Congress will enact some constructive transportation legislation reasonably soon after it assembles in January. This may not add very greatly to the net earnings of the railroads, but it promises to be a step in the right direction.

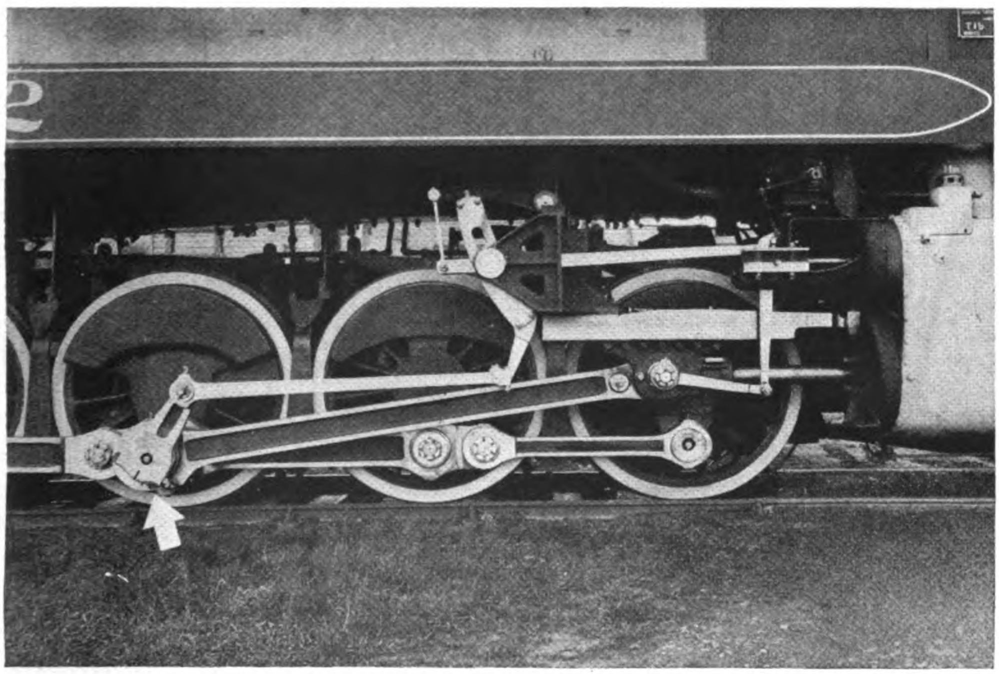
Much may depend on how the Interstate Commerce Commission interprets a more favorable attitude on the part of the public and Congress. It can go a long way in improving railroad conditions if it will concern itself less with details of small importance and pay more attention to the purpose for which it was originally established —*the fostering of the railroads in the public interest.*

It remains for the railroad managements and the employees to continue carrying on an aggressive campaign of education, in order that the public may fully understand the importance of preserving private management. We have been witnessing far too much waste and inefficiency in government-operated and controlled projects.

Roy V. Wright

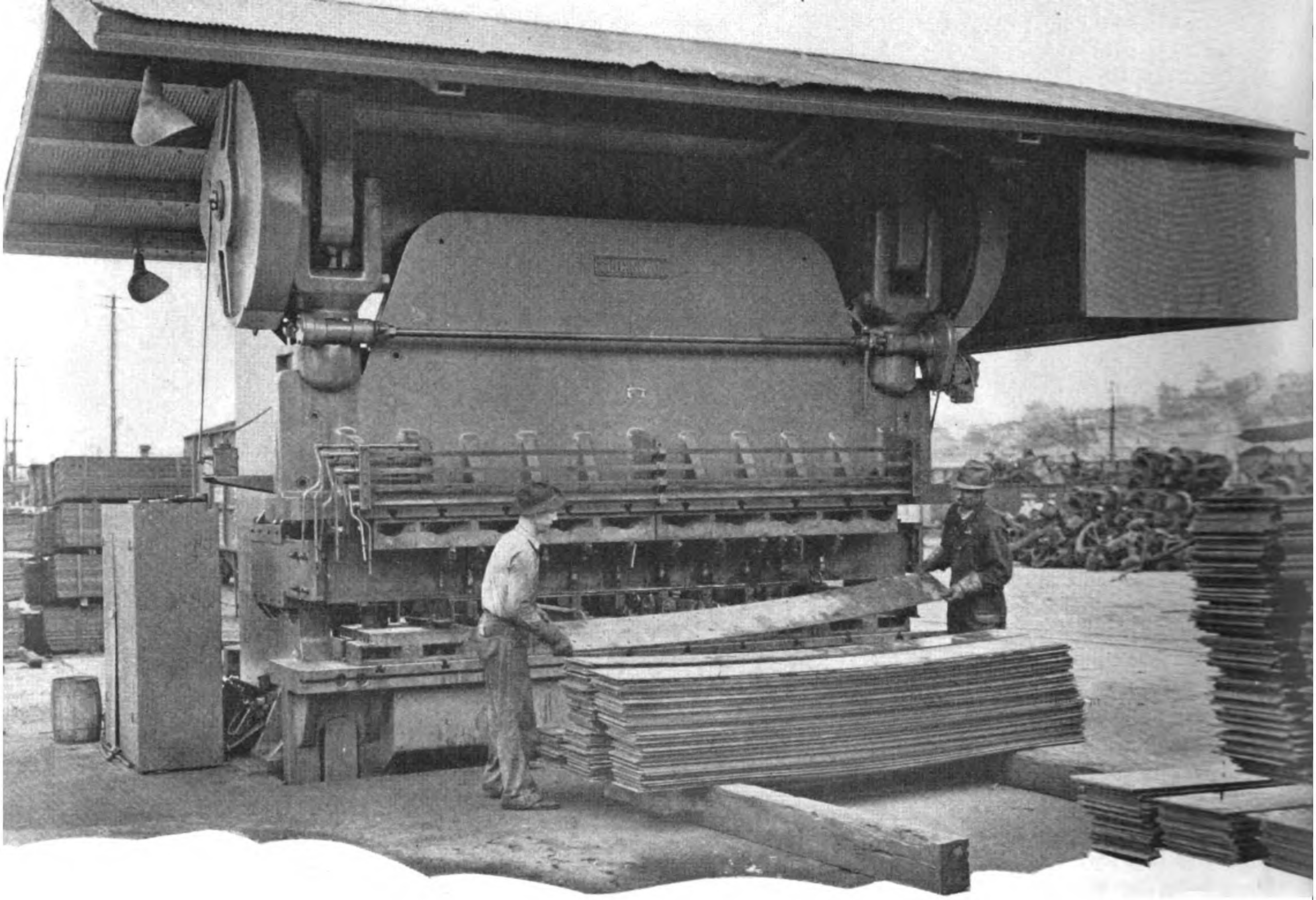
For a decade, Canadian Pacific engines of the Selkirk type have been operated over Rocky Mountain divisions, subjecting Nickel alloy steel parts to high stresses and extremely low temperatures. Performance records proved so favorable that ten new 2-10-4's were recently ordered from the Montreal Locomotive Works. The engine alone weighs 447,000 pounds—with a tractive effort, including booster, of 90,000 pounds—heaviest and most powerful in the British Empire.

C. P. R. *relies on* NICKEL *alloy steels*



Close-up showing main and side rods and main crank pins of Nickel alloy steel. This high strength material lowers weight of reciprocating parts, reduces rail pound and track maintenance costs. Boilers in these new Canadian Pacific locomotives are also made of Nickel alloy steel. You can safely lower the *cost per year* of new equipment or replacements by specifying steels and irons strengthened and toughened with Nickel... Consultation on your problems involving the use of Nickel is invited.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.



Paid For Itself In Four Month

ON one job alone, required for rebuilding of 1800 hopper cars, above recently installed 400 series cinnati All-Steel Press Brake complet refunded the investment in four mon

• • • • •

At the left is another CINCINNATI PRE BRAKE working for a railroad. Job ill trated—bending end on hopper chu Records show that this unit has refunded investment at least four times during 3 years of service.

Every plan for modernization or new construction should include the econom which can be effected with Cincinn All-Steel Press Brakes.

Write for recommendations on your job.

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Better Journal Protection will prevent delays

National Journal Boxes with deflecting fan, thrust ring and Flexo A.A.R. Lids will prevent dust, snow and water from entering the box to contaminate waste and oil.

No more replacements of broken and worn dust guards.

Increased thrust area reduces the number of replacements of broken and worn bearings.

Bearings will have longer life because waste and oil are kept clean.

Lower oil consumption.

Inspection of these boxes in service through severe weather conditions has shown them to be far superior to boxes with conventional dust guards. It has been proven that these boxes require repacking less frequently.

Write for Circular No. 5139.

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General Offices: CLEVELAND, OHIO

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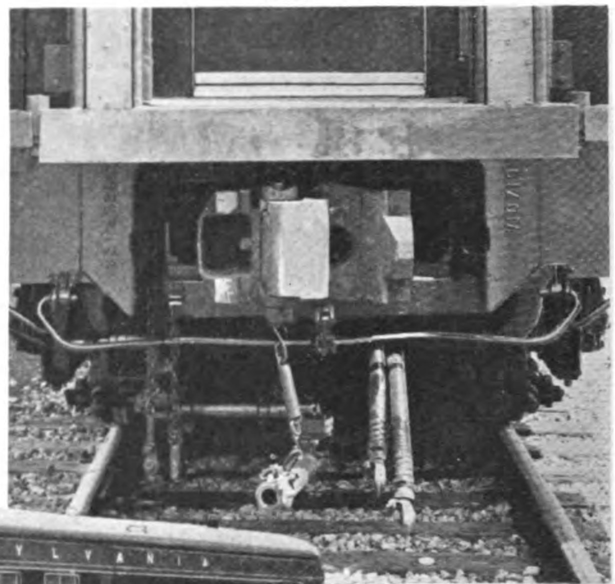
Modern Throughout

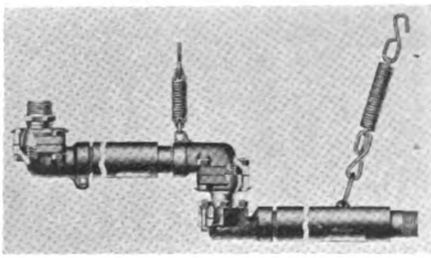
Equipped With

BARCO

FT-2 STEAM-HEAT CONNECTIONS



Above: Showing BARCO Horizontal Steam-Heat Connection on the new Pennsylvania Railroad diners built by American Car & Foundry Company and Pullman-Standard Car Manufacturing Company.



BARCO Car Steam-Heat Connections have Hardened Alloy Steel Metal Wearing Parts.

BARCO

Streamline Diners

recently built for the Pennsylvania Railroad by American Car & Foundry and Pullman-Standard, are all equipped with the improved FT-2 horizontal steam-heat connection designed for cars having low end valve locations.

These new diners, modern in every respect, join a long list of deluxe equipment on American railroads where Barco Products are contributing materially to safety, comfort and economy.

Modern super-power and high-speed trains demand ***extra values*** in locomotive and car specialties.

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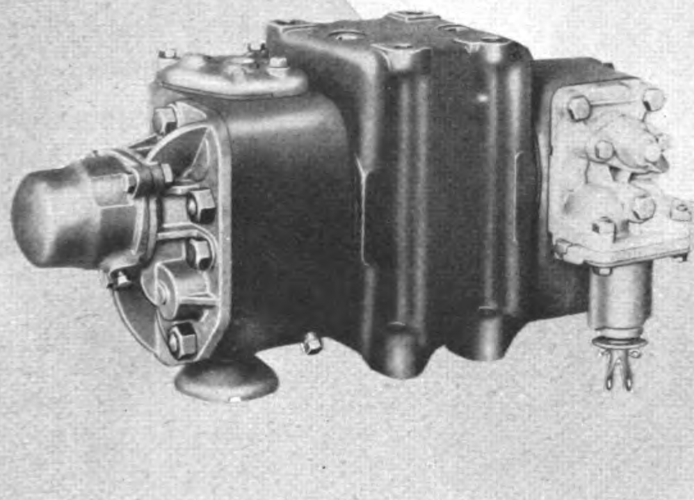

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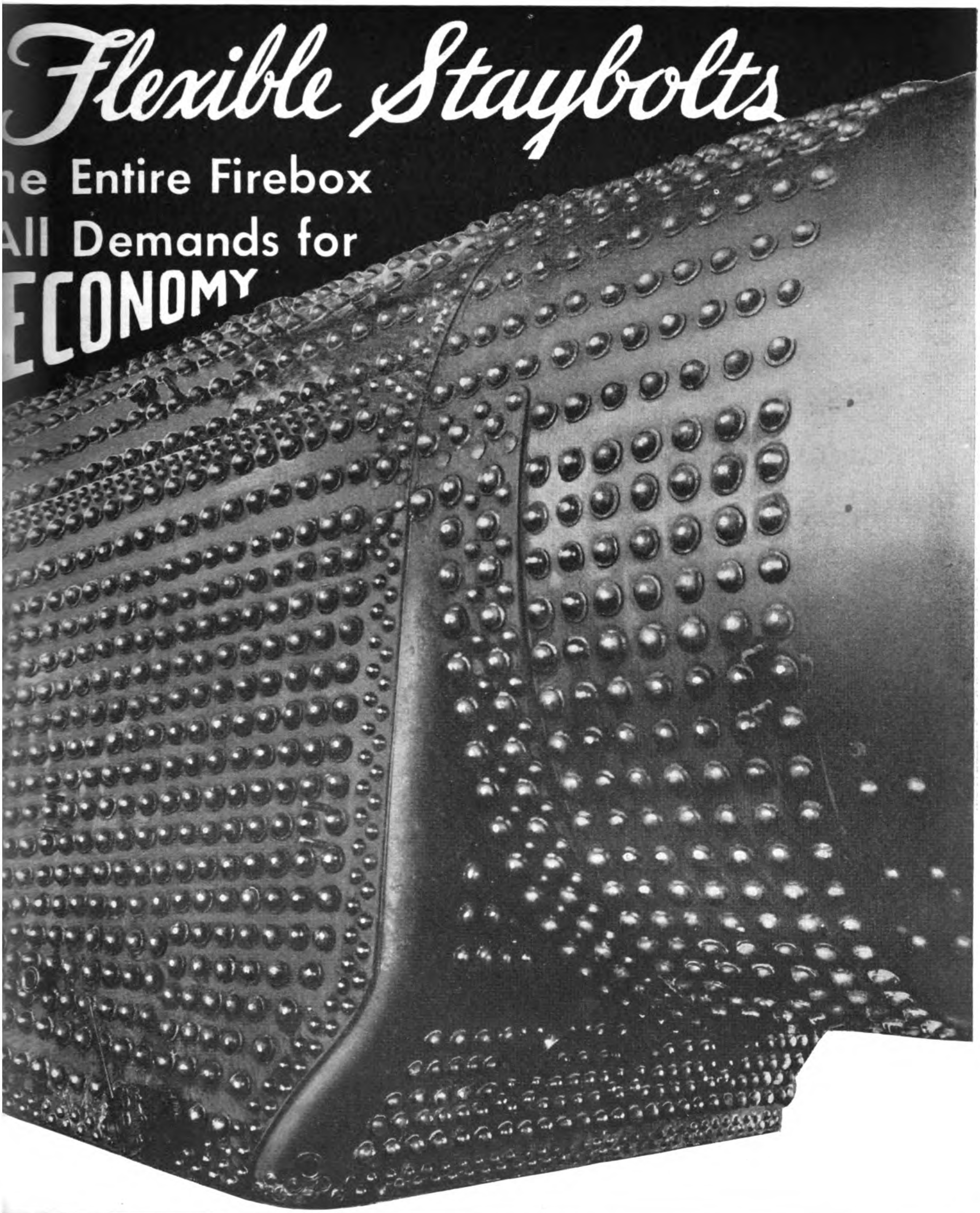

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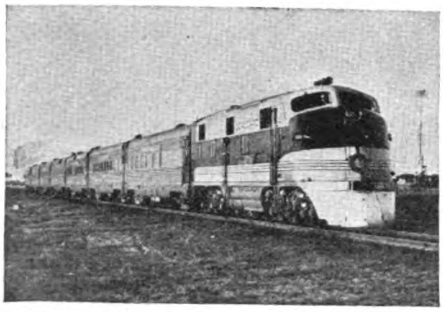
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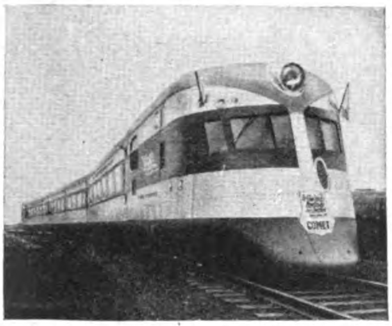
QUALITY WINS!

These famous trains and many other Streamliners are equipped... to obtain *smooth riding* *longer life* and *lower maintenance* with ***dependable springs*** of **VANADIUM STEEL.**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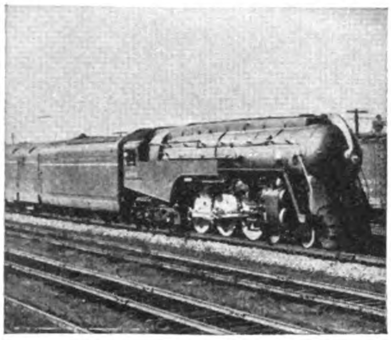
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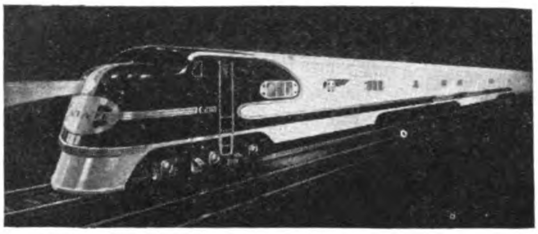
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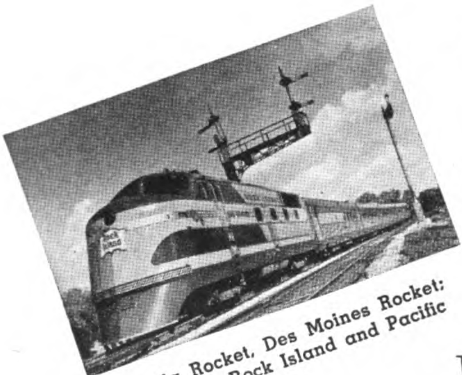
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Write for complete data on NATIONAL Seamless Boiler Tubes. Bulletin No. 12 gives full engineering details as well as valuable tips on good installation practice. Send today for your copy.

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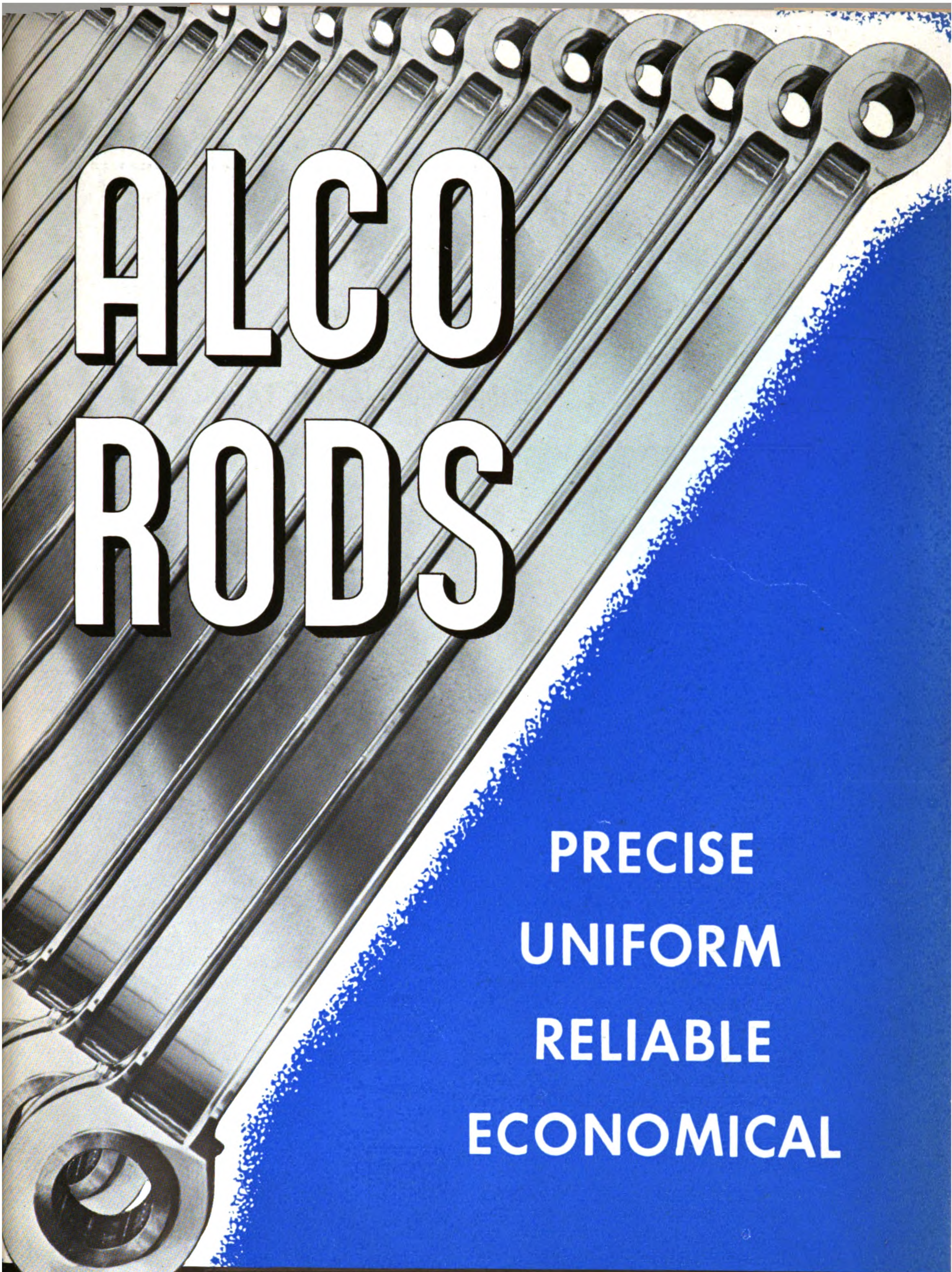

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THIS COMPRESSOR-CONDENSER

is

1. **LIGHT IN WEIGHT**
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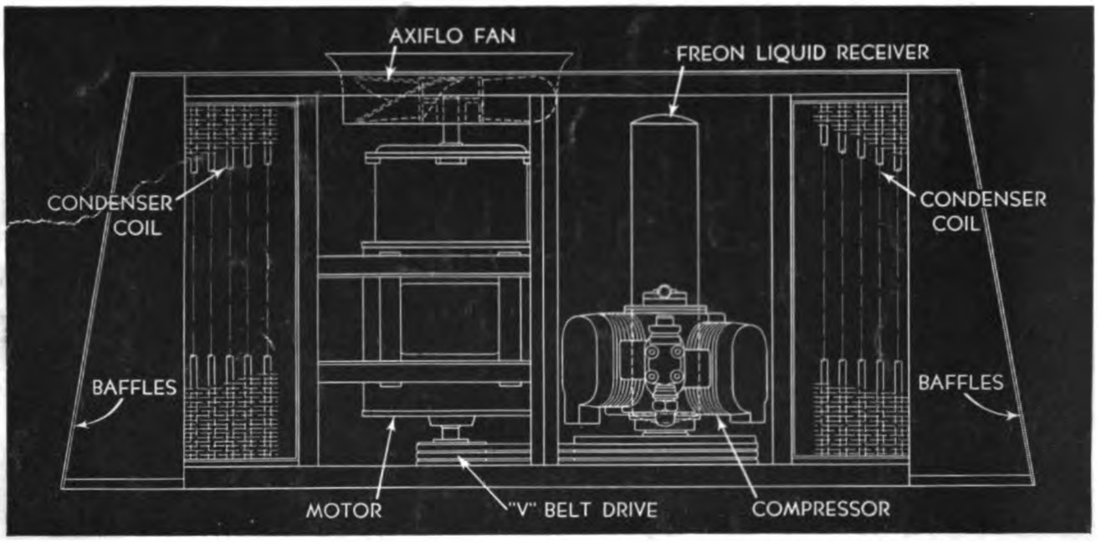

Plan view of Sturtevant Compressor-Condenser Unit, showing very compact construction. Is only 24 inches high, 3 feet 4 inches wide, and 8 feet long, including baffles. Compressor is designed for railway application and contains features which insure maximum operating efficiencies at minimum power requirements.

1. Occupies a minimum of space—24 inches high, 3 ft. 4 inches wide, 8 ft. long, including baffles.

2. Every part readily accessible. For example, radial compressor can be quickly and easily taken down and put together again with the use of ordinary tools.

3. Individual compressor cylinders cut-out automatically as load decreases, eliminating cycling and greatly reducing stops and starts. Effects large power saving and assures much closer temperature control in the car.

4. Individual compressor cylinders also cut-in automatically as compressor starts, thus affording a no-torque, nearly zero starting load—saving power and wear and tear on machine.

5. Equipped with special Sturtevant Axiflo pressure fan, which delivers a large amount of air at very low horsepower.

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